# Shark® 200 & 200T

## Upgradeable Fully Featured Power & Energy Meter

# Installation & Operation Manual

V.1.13

October 9, 2012


**Electro Industries/GaugeTech**

*The Leader In Power Monitoring and Smart Grid Solutions*

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Shark® 200/200T Meter Installation and Operation Manual Version 1.13

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## Customer Service and Support

Customer support is available 9:00 am to 4:30 pm, Eastern Standard Time, Monday through Friday. Please have the model, serial number and a detailed problem description available. If the problem concerns a particular reading, please have all meter readings available. When returning any merchandise to EIG, a return materials authorization number is required. For customer or technical assistance, repair or calibration, phone 516-334-0870 or fax 516-338-4741.

## Product Warranty

Electro Industries/GaugeTech warrants all products to be free from defects in material and workmanship for a period of four years from the date of shipment. During the warranty period, we will, at our option, either repair or replace any product that proves to be defective.

To exercise this warranty, fax or call our customer-support department. You will receive prompt assistance and return instructions. Send the instrument, transportation prepaid, to EIG at 1800 Shames Drive, Westbury, NY 11590. Repairs will be made and the instrument will be returned.

This warranty does not apply to defects resulting from unauthorized modification, misuse, or use for any reason other than electrical power monitoring. The Shark® 200/200T meter is not a user-serviceable product.

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## Use Of Product for Protection

Our products are not to be used for primary over-current protection. Any protection feature in our products is to be used for alarm or secondary protection only.

## Statement of Calibration

Our instruments are inspected and tested in accordance with specifications published by Electro Industries/GaugeTech. The accuracy and a calibration of our instruments are traceable to the National Institute of Standards and Technology through equipment that is calibrated at planned intervals by comparison to certified standards. For optimal performance, EIG recommends that any meter, including those manufactured by EIG, be verified for accuracy on a yearly interval using NIST traceable accuracy standards.

## Disclaimer

The information presented in this publication has been carefully checked for reliability; however, no responsibility is assumed for inaccuracies. The information contained in this document is subject to change without notice.

This symbol indicates that the operator must refer to an explanation in the operating instructions. Please see Chapter 4 for important safety information regarding installation and hookup of the Shark® 200/200T meter.

## About Electro Industries/GaugeTech

Founded in 1975 by engineer and inventor Dr. Samuel Kagan, Electro Industries/GaugeTech changed the face of power monitoring forever with its first breakthrough innovation: an affordable, easy-to-use AC power meter.

Thirty years since its founding, Electro Industries/GaugeTech, the leader in power monitoring and control, continues to revolutionize the industry with the highest quality, cutting edge power monitoring and control technology on the market today. An ISO 9001:2008 certified company, EIG sets the industry standard for advanced power quality and reporting, revenue metering and substation data acquisition and control. EIG products can be found on site at virtually all of today's leading manufacturers, industrial giants and utilities.

EIG products are primarily designed, manufactured, tested and calibrated at our facility in Westbury, New York.

All EIG products are designed, manufactured, tested and calibrated at our facility in Westbury, New York.

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# 1: Three-Phase Power Measurement

This introduction to three-phase power and power measurement is intended to provide only a brief overview of the subject. The professional meter engineer or meter technician should refer to more advanced documents such as the EEI Handbook for Electricity Metering and the application standards for more in-depth and technical coverage of the subject.

## 1.1: Three-Phase System Configurations

Three-phase power is most commonly used in situations where large amounts of power will be used because it is a more effective way to transmit the power and because it provides a smoother delivery of power to the end load. There are two commonly used connections for three-phase power, a wye connection or a delta connection. Each connection has several different manifestations in actual use.

When attempting to determine the type of connection in use, it is a good practice to follow the circuit back to the transformer that is serving the circuit. It is often not possible to conclusively determine the correct circuit connection simply by counting the wires in the service or checking voltages. Checking the transformer connection will provide conclusive evidence of the circuit connection and the relationships between the phase voltages and ground.

### 1.1.1: Wye Connection

The wye connection is so called because when you look at the phase relationships and the winding relationships between the phases it looks like a Y. Figure 1.1 depicts the winding relationships for a wye-connected service. In a wye service the neutral (or center point of the wye) is typically grounded. This leads to common voltages of 208/120 and 480/277 (where the first number represents the phase-to-phase voltage and the second number represents the phase-to-ground voltage).

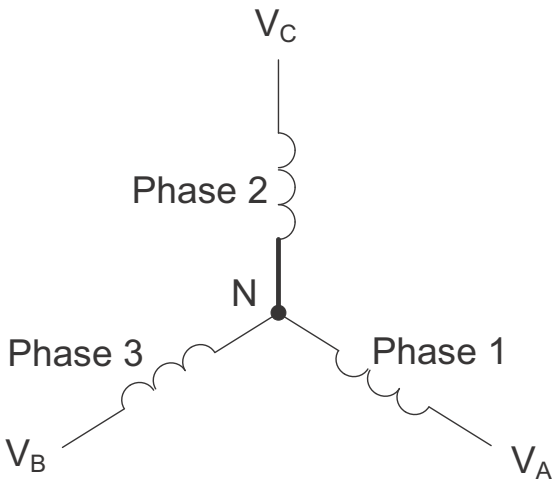



Figure 1.1: Three-phase Wye Winding

The three voltages are separated by 120$^o$ electrically. Under balanced load conditions the currents are also separated by 120$^o$. However, unbalanced loads and other conditions can cause the currents to depart from the ideal 120$^o$ separation. Three-phase voltages and currents are usually represented with a phasor diagram. A phasor diagram for the typical connected voltages and currents is shown in Figure 1.2.

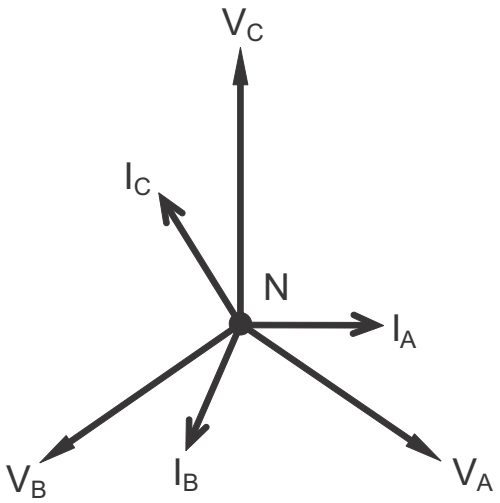



Figure 1.2: Phasor Diagram Showing Three-phase Voltages and Currents

The phasor diagram shows the 120$^{o}$ angular separation between the phase voltages. The phase-to-phase voltage in a balanced three-phase wye system is 1.732 times the phase-to-neutral voltage. The center point of the wye is tied together and is typically grounded. Table 1.1 shows the common voltages used in the United States for wye-connected systems.

| Phase to Ground Voltage | Phase to Phase Voltage |
|---|---|
| 120 volts | 208 volts |
| 277 volts | 480 volts |
| 2,400 volts | 4,160 volts |
| 7,200 volts | 12,470 volts |
| 7,620 volts | 13,200 volts |

Table 1: Common Phase Voltages on Wye Services

Usually a wye-connected service will have four wires: three wires for the phases and one for the neutral. The three-phase wires connect to the three phases (as shown in Figure 1.1). The neutral wire is typically tied to the ground or center point of the wye.

In many industrial applications the facility will be fed with a four-wire wye service but only three wires will be run to individual loads. The load is then often referred to as a delta-connected load but the service to the facility is still a wye service; it contains four wires if you trace the circuit back to its source (usually a transformer). In this type of connection the phase to ground voltage will be the phase-to-ground voltage indicated in Table 1, even though a neutral or ground wire is not physically present at the load. The transformer is the best place to determine the circuit connection type because this is a location where the voltage reference to ground can be conclusively identified.

### 1.1.2: Delta Connection

Delta-connected services may be fed with either three wires or four wires. In a three-phase delta service the load windings are connected from phase-to-phase rather than from phase-to-ground. Figure 1.3 shows the physical load connections for a delta service.

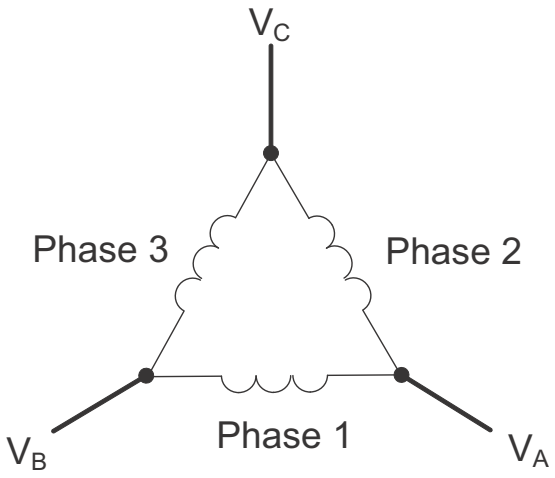



Figure 1.3: Three-phase Delta Winding Relationship

In this example of a delta service, three wires will transmit the power to the load. In a true delta service, the phase-to-ground voltage will usually not be balanced because the ground is not at the center of the delta.

Figure 1.4 shows the phasor relationships between voltage and current on a three-phase delta circuit.

In many delta services, one corner of the delta is grounded. This means the phase to ground voltage will be zero for one phase and will be full phase-to-phase voltage for the other two phases. This is done for protective purposes.

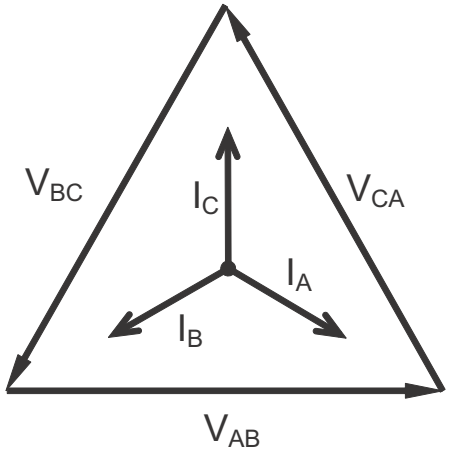



Figure 1.4: Phasor Diagram, Three-Phase Voltages and Currents, Delta-Connected

Another common delta connection is the four-wire, grounded delta used for lighting loads. In this connection the center point of one winding is grounded. On a 120/240 volt, four-wire, grounded delta service the phase-to-ground voltage would be 120 volts on two phases and 208 volts on the third phase. Figure 1.5 shows the phasor diagram for the voltages in a three-phase, four-wire delta system.

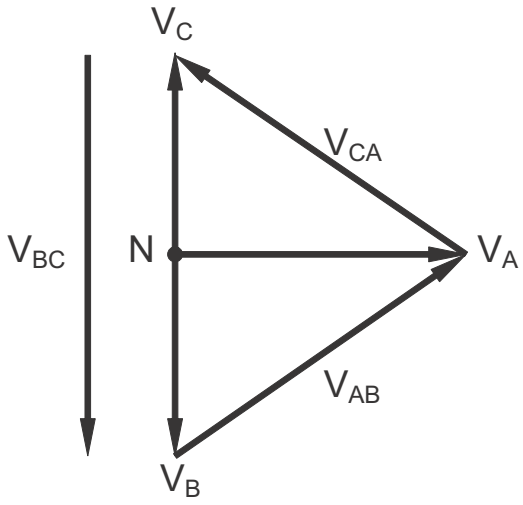



Figure 1.5: Phasor Diagram Showing Three-phase Four-Wire Delta-Connected System

### 1.1.3: Blondell's Theorem and Three Phase Measurement

In 1893 an engineer and mathematician named Andre E. Blondell set forth the first scientific basis for polyphase metering. His theorem states:

If energy is supplied to any system of conductors through N wires, the total power in the system is given by the algebraic sum of the readings of N wattmeters so arranged that each of the N wires contains one current coil, the corresponding potential coil being connected between that wire and some common point. If this common point is on one of the N wires, the measurement may be made by the use of N-1 Wattmeters.

The theorem may be stated more simply, in modern language:

In a system of N conductors, N-1 meter elements will measure the power or energy taken provided that all the potential coils have a common tie to the conductor in which there is no current coil.

Three-phase power measurement is accomplished by measuring the three individual phases and adding them together to obtain the total three phase value. In older analog meters, this measurement was accomplished using up to three separate elements. Each element combined the single-phase voltage and current to produce a torque on the meter disk. All three elements were arranged around the disk so that the disk was subjected to the combined torque of the three elements. As a result the disk would turn at a higher speed and register power supplied by each of the three wires.

According to Blondell's Theorem, it was possible to reduce the number of elements under certain conditions. For example, a three-phase, three-wire delta system could be correctly measured with two elements (two potential coils and two current coils) if the potential coils were connected between the three phases with one phase in common.

In a three-phase, four-wire wye system it is necessary to use three elements. Three voltage coils are connected between the three phases and the common neutral conductor. A current coil is required in each of the three phases.

In modern digital meters, Blondell's Theorem is still applied to obtain proper metering. The difference in modern meters is that the digital meter measures each phase voltage and current and calculates the single-phase power for each phase. The meter then sums the three phase powers to a single three-phase reading.

Some digital meters calculate the individual phase power values one phase at a time. This means the meter samples the voltage and current on one phase and calculates a power value. Then it samples the second phase and calculates the power for the second phase. Finally, it samples the third phase and calculates that phase power. After sampling all three phases, the meter combines the three readings to create the equivalent three-phase power value. Using mathematical averaging techniques, this method can derive a quite accurate measurement of three-phase power.

More advanced meters actually sample all three phases of voltage and current simultaneously and calculate the individual phase and three-phase power values. The advantage of simultaneous sampling is the reduction of error introduced due to the difference in time when the samples were taken.

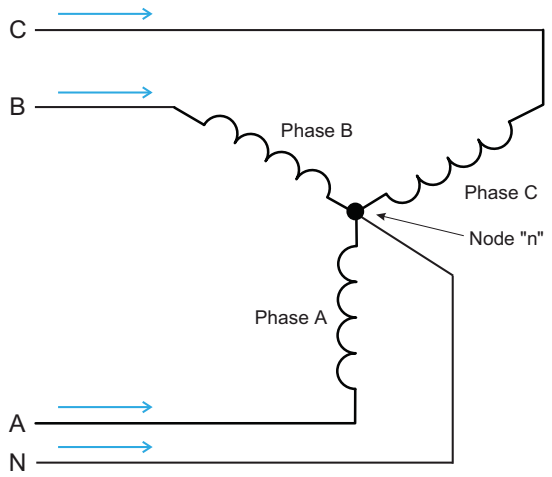



Figure 1.6: Three-Phase Wye Load Illustrating Kirchhoff's Law and Blondell's Theorem

Blondell's Theorem is a derivation that results from Kirchhoff's Law. Kirchhoff's Law states that the sum of the currents into a node is zero. Another way of stating the same thing is that the current into a node (connection point) must equal the current out of the node. The law can be applied to measuring three-phase loads. Figure 1.6 shows a typical connection of a three-phase load applied to a three-phase, four-wire service. Krichhoff's Law holds that the sum of currents A, B, C and N must equal zero or that the sum of currents into Node "n" must equal zero.

If we measure the currents in wires A, B and C, we then know the current in wire N by Kirchhoff's Law and it is not necessary to measure it. This fact leads us to the conclusion of Blondell's Theorem- that we only need to measure the power in three of

the four wires if they are connected by a common node. In the circuit of Figure 1.6 we must measure the power flow in three wires. This will require three voltage coils and three current coils (a three-element meter). Similar figures and conclusions could be reached for other circuit configurations involving Delta-connected loads.

## 1.2: Power, Energy and Demand

It is quite common to exchange power, energy and demand without differentiating between the three. Because this practice can lead to confusion, the differences between these three measurements will be discussed.

Power is an instantaneous reading. The power reading provided by a meter is the present flow of watts. Power is measured immediately just like current. In many digital meters, the power value is actually measured and calculated over a one second interval because it takes some amount of time to calculate the RMS values of voltage and current. But this time interval is kept small to preserve the instantaneous nature of power.

Energy is always based on some time increment; it is the integration of power over a defined time increment. Energy is an important value because almost all electric bills are based, in part, on the amount of energy used.

Typically, electrical energy is measured in units of kilowatt-hours (kWh). A kilowatt-hour represents a constant load of one thousand watts (one kilowatt) for one hour. Stated another way, if the power delivered (instantaneous watts) is measured as 1,000 watts and the load was served for a one hour time interval then the load would have absorbed one kilowatt-hour of energy. A different load may have a constant power requirement of 4,000 watts. If the load were served for one hour it would absorb four kWh. If the load were served for 15 minutes it would absorb ¼ of that total or one kWh.

Figure 1.7 shows a graph of power and the resulting energy that would be transmitted as a result of the illustrated power values. For this illustration, it is assumed that the power level is held constant for each minute when a measurement is taken. Each bar in the graph will represent the power load for the one-minute increment of time. In real life the power value moves almost constantly.

The data from Figure 1.7 is reproduced in Table 2 to illustrate the calculation of energy. Since the time increment of the measurement is one minute and since we

specified that the load is constant over that minute, we can convert the power reading to an equivalent consumed energy reading by multiplying the power reading times 1/60 (converting the time base from minutes to hours).

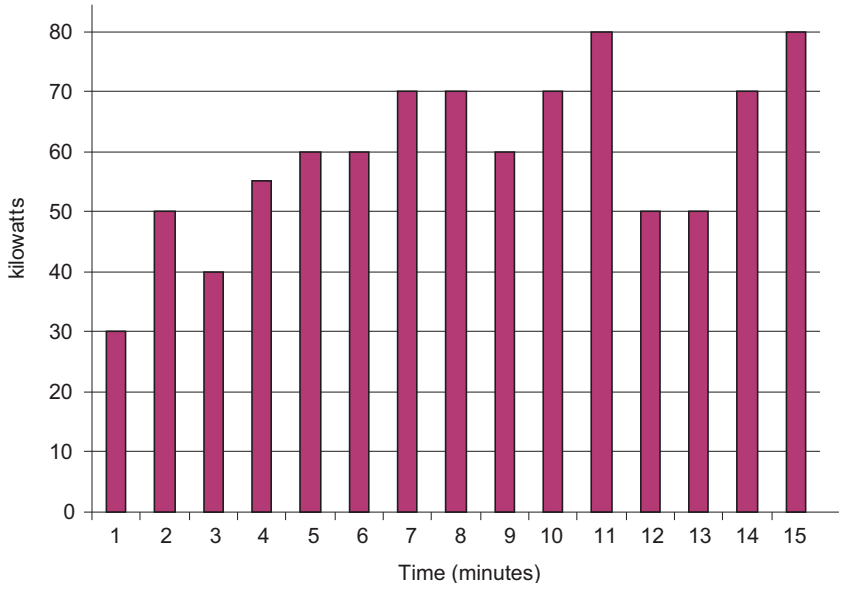



Figure 1.7: Power Use over Time

| Time Interval (minute) | Power (kW) | Energy (kWh) | Accumulated Energy (kWh) |
|---|---|---|---|
| 1 | 30 | 0.50 | 0.50 |
| 2 | 50 | 0.83 | 1.33 |
| 3 | 40 | 0.67 | 2.00 |
| 4 | 55 | 0.92 | 2.92 |
| 5 | 60 | 1.00 | 3.92 |
| 6 | 60 | 1.00 | 4.92 |
| 7 | 70 | 1.17 | 6.09 |
| 8 | 70 | 1.17 | 7.26 |
| 9 | 60 | 1.00 | 8.26 |
| 10 | 70 | 1.17 | 9.43 |
| 11 | 80 | 1.33 | 10.76 |
| 12 | 50 | 0.83 | 12.42 |
| 13 | 50 | 0.83 | 12.42 |
| 14 | 70 | 1.17 | 13.59 |
| 15 | 80 | 1.33 | 14.92 |

Table 1.2: Power and Energy Relationship over Time

As in Table 1.2, the accumulated energy for the power load profile of Figure 1.7 is 14.92 kWh.

Demand is also a time-based value. The demand is the average rate of energy use over time. The actual label for demand is kilowatt-hours/hour but this is normally reduced to kilowatts. This makes it easy to confuse demand with power, but demand is not an instantaneous value. To calculate demand it is necessary to accumulate the energy readings (as illustrated in Figure 1.7) and adjust the energy reading to an hourly value that constitutes the demand.

In the example, the accumulated energy is 14.92 kWh. But this measurement was made over a 15-minute interval. To convert the reading to a demand value, it must be normalized to a 60-minute interval. If the pattern were repeated for an additional three 15-minute intervals the total energy would be four times the measured value or

59.68 kWh. The same process is applied to calculate the 15-minute demand value. The demand value associated with the example load is 59.68 kWh/hr or 59.68 kWd. Note that the peak instantaneous value of power is 80 kW, significantly more than the demand value.

Figure 1.8 shows another example of energy and demand. In this case, each bar represents the energy consumed in a 15-minute interval. The energy use in each interval typically falls between 50 and 70 kWh. However, during two intervals the energy rises sharply and peaks at 100 kWh in interval number 7. This peak of usage will result in setting a high demand reading. For each interval shown the demand value would be four times the indicated energy reading. So interval 1 would have an associated demand of 240 kWh/hr. Interval 7 will have a demand value of 400 kWh/hr. In the data shown, this is the peak demand value and would be the number that would set the demand charge on the utility bill.

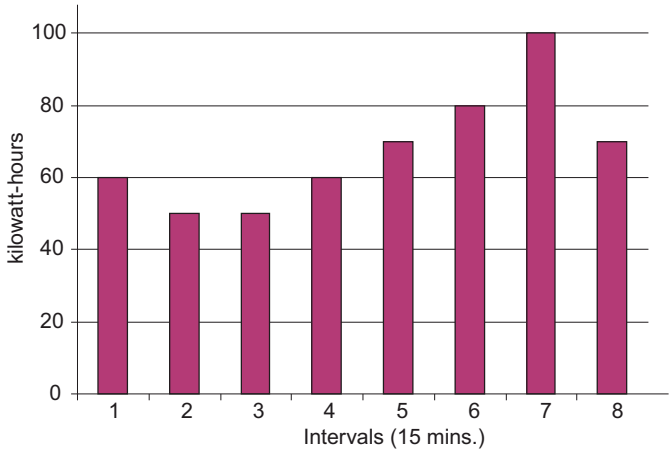



Figure 1.8: Energy Use and Demand

As can be seen from this example, it is important to recognize the relationships between power, energy and demand in order to control loads effectively or to monitor use correctly.

## 1.3: Reactive Energy and Power Factor

The real power and energy measurements discussed in the previous section relate to the quantities that are most used in electrical systems. But it is often not sufficient to only measure real power and energy. Reactive power is a critical component of the total power picture because almost all real-life applications have an impact on reactive power. Reactive power and power factor concepts relate to both load and generation applications. However, this discussion will be limited to analysis of reactive power and power factor as they relate to loads. To simplify the discussion, generation will not be considered.

Real power (and energy) is the component of power that is the combination of the voltage and the value of corresponding current that is directly in phase with the voltage. However, in actual practice the total current is almost never in phase with the voltage. Since the current is not in phase with the voltage, it is necessary to consider both the inphase component and the component that is at quadrature (angularly rotated $90^o$ or perpendicular) to the voltage. Figure 1.9 shows a single-phase voltage and current and breaks the current into its in-phase and quadrature components.

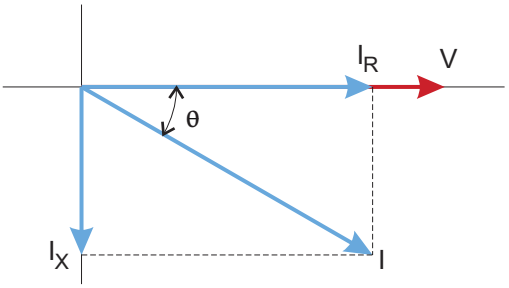



Figure 1.9: Voltage and Complex Current

The voltage (V) and the total current (I) can be combined to calculate the apparent power or VA. The voltage and the in-phase current ($I_R$) are combined to produce the real power or watts. The voltage and the quadrature current ($I_X$) are combined to calculate the reactive power.

The quadrature current may be lagging the voltage (as shown in Figure 1.9) or it may lead the voltage. When the quadrature current lags the voltage the load is requiring both real power (watts) and reactive power (VARs). When the quadrature current

leads the voltage the load is requiring real power (watts) but is delivering reactive power (VARs) back into the system; that is VARs are flowing in the opposite direction of the real power flow.

Reactive power (VARs) is required in all power systems. Any equipment that uses magnetization to operate requires VARs. Usually the magnitude of VARs is relatively low compared to the real power quantities. Utilities have an interest in maintaining VAR requirements at the customer to a low value in order to maximize the return on plant invested to deliver energy. When lines are carrying VARs, they cannot carry as many watts. So keeping the VAR content low allows a line to carry its full capacity of watts. In order to encourage customers to keep VAR requirements low, some utilities impose a penalty if the VAR content of the load rises above a specified value.

A common method of measuring reactive power requirements is power factor. Power factor can be defined in two different ways. The more common method of calculating power factor is the ratio of the real power to the apparent power. This relationship is expressed in the following formula:

Total PF = real power / apparent power = watts/VA

This formula calculates a power factor quantity known as Total Power Factor. It is called Total PF because it is based on the ratios of the power delivered. The delivered power quantities will include the impacts of any existing harmonic content. If the voltage or current includes high levels of harmonic distortion the power values will be affected. By calculating power factor from the power values, the power factor will include the impact of harmonic distortion. In many cases this is the preferred method of calculation because the entire impact of the actual voltage and current are included.

A second type of power factor is Displacement Power Factor. Displacement PF is based on the angular relationship between the voltage and current. Displacement power factor does not consider the magnitudes of voltage, current or power. It is solely based on the phase angle differences. As a result, it does not include the impact of harmonic distortion. Displacement power factor is calculated using the following equation:

$$\text{Displacement PF} = \cos\theta$$

where θ is the angle between the voltage and the current (see Fig. 1.9).

In applications where the voltage and current are not distorted, the Total Power Factor will equal the Displacement Power Factor. But if harmonic distortion is present, the two power factors will not be equal.

## 1.4: Harmonic Distortion

Harmonic distortion is primarily the result of high concentrations of non-linear loads. Devices such as computer power supplies, variable speed drives and fluorescent light ballasts make current demands that do not match the sinusoidal waveform of AC electricity. As a result, the current waveform feeding these loads is periodic but not sinusoidal. Figure 1.10 shows a normal, sinusoidal current waveform. This example has no distortion.

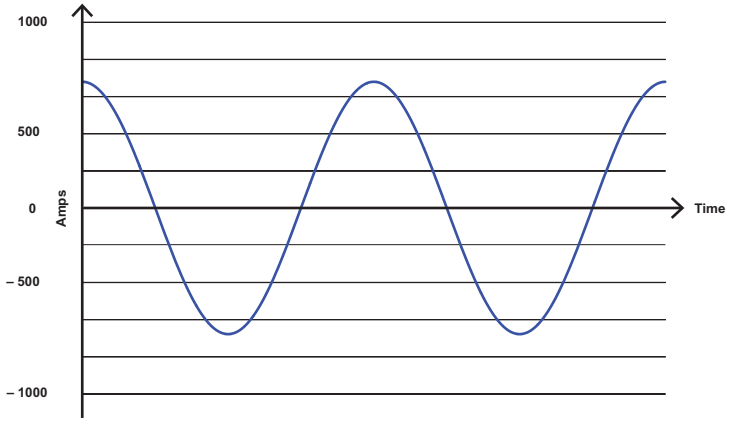



Figure 1.10: Nondistorted Current Waveform

Figure 1.11 shows a current waveform with a slight amount of harmonic distortion. The waveform is still periodic and is fluctuating at the normal 60 Hz frequency. However, the waveform is not a smooth sinusoidal form as seen in Figure 1.10.

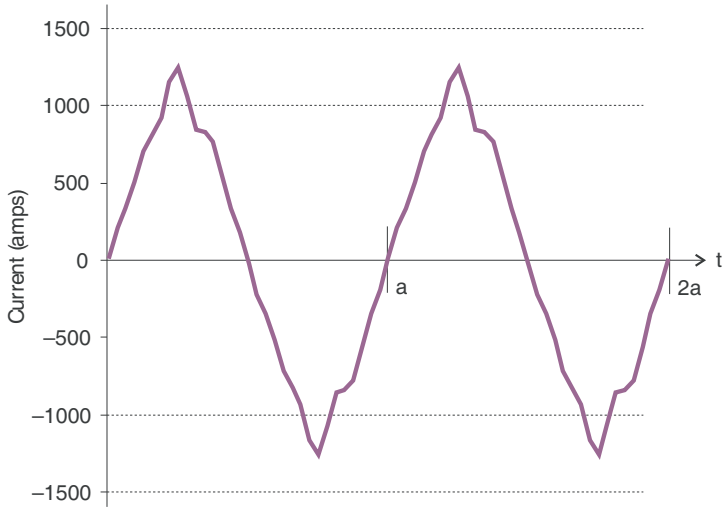



Figure 1.11: Distorted Current Waveform

The distortion observed in Figure 1.11 can be modeled as the sum of several sinusoidal waveforms of frequencies that are multiples of the fundamental 60 Hz frequency. This modeling is performed by mathematically disassembling the distorted waveform into a collection of higher frequency waveforms.

These higher frequency waveforms are referred to as harmonics. Figure 1.12 shows the content of the harmonic frequencies that make up the distortion portion of the waveform in Figure 1.11.

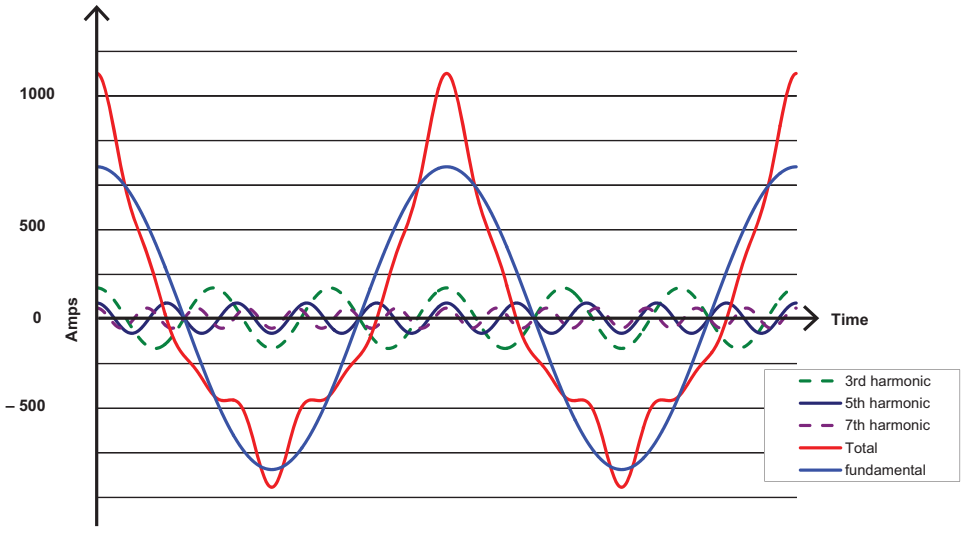



Figure 1.12: Waveforms of the Harmonics

The waveforms shown in Figure 1.12 are not smoothed but do provide an indication of the impact of combining multiple harmonic frequencies together.

When harmonics are present it is important to remember that these quantities are operating at higher frequencies. Therefore, they do not always respond in the same manner as 60 Hz values.

Inductive and capacitive impedance are present in all power systems. We are accustomed to thinking about these impedances as they perform at 60 Hz. However, these impedances are subject to frequency variation.

$X_L = j\omega L$ and

$X_C = 1/j\omega C$

At 60 Hz, $\omega = 377$; but at 300 Hz (5th harmonic) $\omega = 1{,}885$. As frequency changes impedance changes and system impedance characteristics that are normal at 60 Hz may behave entirely differently in the presence of higher order harmonic waveforms.

Traditionally, the most common harmonics have been the low order, odd frequencies, such as the 3rd, 5th, 7th, and 9th. However newer, new-linear loads are introducing significant quantities of higher order harmonics.

Since much voltage monitoring and almost all current monitoring is performed using instrument transformers, the higher order harmonics are often not visible. Instrument transformers are designed to pass 60 Hz quantities with high accuracy. These devices, when designed for accuracy at low frequency, do not pass high frequencies with high accuracy; at frequencies above about 1200 Hz they pass almost no information. So when instrument transformers are used, they effectively filter out higher frequency harmonic distortion making it impossible to see.

However, when monitors can be connected directly to the measured circuit (such as direct connection to a 480 volt bus) the user may often see higher order harmonic distortion. An important rule in any harmonics study is to evaluate the type of equipment and connections before drawing a conclusion. Not being able to see harmonic distortion is not the same as not having harmonic distortion.

It is common in advanced meters to perform a function commonly referred to as waveform capture. Waveform capture is the ability of a meter to capture a present picture of the voltage or current waveform for viewing and harmonic analysis.

Typically a waveform capture will be one or two cycles in duration and can be viewed as the actual waveform, as a spectral view of the harmonic content, or a tabular view showing the magnitude and phase shift of each harmonic value. Data collected with waveform capture is typically not saved to memory. Waveform capture is a real-time data collection event.

Waveform capture should not be confused with waveform recording that is used to record multiple cycles of all voltage and current waveforms in response to a transient condition.

## 1.5: Power Quality

Power quality can mean several different things. The terms "power quality" and "power quality problem" have been applied to all types of conditions. A simple definition of "power quality problem" is any voltage, current or frequency deviation that results in mis-operation or failure of customer equipment or systems. The causes of power quality problems vary widely and may originate in the customer equipment, in an adjacent customer facility or with the utility.

In his book Power Quality Primer, Barry Kennedy provided information on different types of power quality problems. Some of that information is summarized in Table 1.3.

| Cause | Disturbance Type | Source |
|---|---|---|
| Impulse transient | Transient voltage disturbance, sub-cycle duration | Lightning<br>Electrostatic discharge<br>Load switching<br>Capacitor switching |
| Oscillatory transient with decay | Transient voltage, sub-cycle duration | Line/cable switching<br>Capacitor switching<br>Load switching |
| Sag/swell | RMS voltage, multiple cycle duration | Remote system faults |
| Interruptions | RMS voltage, multiple seconds or longer duration | System protection<br>Circuit breakers<br>Fuses<br>Maintenance |
| Under voltage/over voltage | RMS voltage, steady state, multiple seconds or longer duration | Motor starting<br>Load variations<br>Load dropping |
| Voltage flicker | RMS voltage, steady state, repetitive condition | Intermittent loads<br>Motor starting<br>Arc furnaces |
| Harmonic distortion | Steady state current or voltage, long-term duration | Non-linear loads<br>System resonance |

Table 1.3: Typical Power Quality Problems and Sources

It is often assumed that power quality problems originate with the utility. While it is true that may power quality problems can originate with the utility system, many problems originate with customer equipment. Customer-caused problems may manifest themselves inside the customer location or they may be transported by the utility system to another adjacent customer. Often, equipment that is sensitive to power quality problems may in fact also be the cause of the problem.

If a power quality problem is suspected, it is generally wise to consult a power quality professional for assistance in defining the cause and possible solutions to the problem.

# 2: Meter Overview and Specifications

## 2.1: Shark® 200 Meter Overview

The Shark® 200 meter is a multifunction, data logging, power and energy meter with waveform recording capability, designed to be used in electrical substations, panel boards, as a power meter for OEM equipment, and as a primary revenue meter, due to its high performance measurement capability. The unit provides multifunction measurement of all electrical parameters and makes the data available in multiple formats via display, communication systems, and analog retransmits. The unit also has data logging and load profiling to provide historical data analysis, and waveform recording that allows for enhanced power quality analysis.

Figure 2.1: Shark® 200 meter

The Shark® 200 meter offers up to 4 MegaBytes of Flash memory. The unit provides you with up to seven logs: three historical logs, a log of limit alarms, a log of I/O changes, a waveform log, and a sequence of events log. (See NOTE on Flash memory on page 2-6.)

The purposes of these features include historical load profiling, voltage analysis, and recording power factor distribution. The Shark® 200 meter's real-time clock allows all events to be time stamped.

Optional 10/100BaseT Ethernet capability is available for the meter. When it is equipped with an Ethernet card, the meter's real-time clock can be synchronized with an outside Network Time Protocol (NTP) server (see the *Communicator EXT*™ *User Manual* for instructions on using this feature.) A Shark® meter with an Ethernet card also becomes a Web server. See Chapter 8 for more information on this feature.

The Shark® 200 meter is designed with advanced measurement capabilities, allowing it to achieve high performance accuracy. It is specified as a 0.2% class energy meter for billing applications as well as a highly accurate panel indication meter. It supplies 0.001 Hz Frequency measurement which meets generating stations' requirements.

The Shark® 200 meter provides additional capabilities, including standard RS485, Modbus and DNP 3.0 protocol support, an IrDA port for remote interrogation, and Option cards that can be added at any time.

**Features of the Shark® 200 meter include:**

- 0.2% Class revenue certifiable energy and demand metering
- Meets ANSI C12.20 (0.2%) and IEC 62053-22 (0.2%) classes
- Multifunction measurement including voltage, current, power, frequency, energy, etc.
- Optional secondary Voltage display (see Chapter 5 in the *Communicator EXT*™ *User Manual* for instructions on setting up this feature*)
- Power quality measurements (%THD and Alarm Limits) - for meters with V-Switch™ keys 3-6, symmetrical components, Voltage unbalance, and current unbalance are also available and can be used with the Limits functionality (see Chapter 5 in the *Communicator EXT*™ *User Manual* for instructions on using this feature*)
- V-Switch™ Key technology - field upgradable without removing installed meter
- Percentage of Load bar for analog meter reading
- 0.001% Frequency measurement for Generating stations
- Interval energy logging
- Line frequency time synchronization
- Easy to use faceplate programming
- IrDA port for laptop PC remote read
- RS485 communication
- Optional I/O Cards (including 10/100BaseT Ethernet) - field upgradable without removing installed meter

- Sampling rate of up to 512 samples per cycle for waveform recording
- Transformer/Line Loss compensation (see Chapter 5 and Appendix B in the *Communicator EXT*™ *User Manual* for instructions on using this feature*)
- CT/PT compensation (see Chapter 5 in the *Communicator EXT*™ *User Manual* for instructions on using this feature*)

Figure 2.2: Shark® 200 Transducer

***** Access the *Communicator EXT*™ *User Manual* from the Communicator EXT™ Product CD or by clicking **Help>Contents** from the Communicator EXT™ Main screen.

In addition to the Shark® 200 meter/transducer configuration, a Shark® 200T transducer configuration is available. The Shark® 200T transducer is a digital transducer only unit, providing RS485 communication via Modbus RTU, Modbus ASCII or DNP 3.0 protocols. The unit is designed to install using DIN Rail mounting (see Section 3.4 for Shark® 200T transducer mounting information).

### 2.1.1: Voltage and Current Inputs

#### Universal Voltage Inputs

Voltage inputs allow measurement up to Nominal 480VAC (Phase to Reference) and 600VAC (Phase to Phase). This insures proper meter safety when wiring directly to high Voltage systems. The unit will perform to specification on 69 Volt, 120 Volt, 230 Volt, 277 Volt, and 347 Volt power systems.

**NOTE:** Higher Voltages require the use of potential transformers (PTs).

#### Current Inputs

The unit supports a 5 Amp or a 1 Amp secondary for current measurements.

**NOTE**: The secondary current must be specified and ordered with the meter.

The Shark® 200 meter's current inputs use a unique dual input method:

Method 1: CT Pass Through:

The CT wire passes directly through the meter without any physical termination on the meter. This insures that the meter cannot be a point of failure on the CT circuit. This is preferable for utility users when sharing relay class CTs. No Burden is added to the secondary CT circuit.

Method 2: Current "Gills":

This unit additionally provides ultra-rugged termination pass through bars that allow CT leads to be terminated on the meter. This, too, eliminates any possible point of failure at the meter. This is a preferred technique for insuring that relay class CT integrity is not compromised (the CT will not open in a fault condition).

### 2.1.2: Ordering Information

**Shark200 - 60 - 10- V2- D -INP100S - X**

1 2 3 4 5 6 7

1. Model:

   Shark® 200 Meter/Transducer

   Shark® 200T Transducer (no display)

2. Frequency:

   50: 50 Hz System

   60: 60 Hz System

3. Current Input:

   10: 5 Amp Secondary

   2: 1 Amp Secondary

4. V-Switch™ Key Pack:

   V1: Multifunction meter only

V2: Above, with 2 MegaBytes data logging memory

V3: Above, with %THD

V4: Above, with limit and control functions

V5: Above, with 3 MegaBytes data logging memory and 64 samples per cycle waveform recorder

V6: Above, with 4 MegaBytes data logging memory and 512 samples per cycle waveform recorder

See Section 2.1.3 for more information and instructions on obtaining a V-Switch™ key.

5. Power Supply:

D2 Option: Universal, (90 to 265) VAC @50/60Hz or (100 to 370) VDC

D Option: (18-60) VDC

6 and 7. I/O Slots 1 and 2 (see Chapter 7 for I/O Card Specifications):

X: None

INP100S: 10/100BaseT Ethernet

RO1S: 2 Relay outputs/2 Status inputs

PO1S: 4 Pulse outputs/4 Status inputs

1mAOS: 4 Channel Analog output 0-1 (bidirectional)

20mAOS: 4 Channel Analog output 4-20mA

FOSTS: Fiber Optic Output ST terminated

FOVPS: Fiber Optic Output Versatile Link terminated

**Example:**

Shark200-60-10-V2-D-INP100S-X

(Shark® 200 meter with 60 Hz System, 5 Amp Secondary, V-2 V-Switch™ key, 18-60 VDC power supply, 10/100BaseT Ethernet in Card Slot 1 and no card in Card Slot 2)

### 2.1.3: V-Switch™ Key Technology

The Shark® 200 meter is equipped with V-Switch™ key technology, a virtual firmware-based switch that lets you enable meter features through software communication. V-Switch™ key technology allows meter upgrades after installation without removal from service.

Available V-Switch™ key upgrades are as follows:

- V-Switch™ key 1 (V-1): Multifunction measurement
- V-Switch™ key 2 (V-2): Multifunction measurement and 2 MegaBytes* for data logging
- V-Switch™ key 3 (V-3): Multifunction measurement with harmonics and 2 Mega-Bytes* for data logging
- V-Switch™ key 4 (V-4): Multifunction measurement with harmonics, 2 MegaBytes* for data logging, and limit and control functions
- V-Switch™ key 5 (V-5): Multifunction measurement with harmonics, 3 MegaBytes* for data logging, limit and control functions, and 64 samples per cycle waveform recorder
- V-Switch™ key 6 (V-6): Multifunction measurement with harmonics, 4 MegaBytes* for data logging, limit and control functions, and 512 samples per cycle waveform recorder

***** Because the memory is flash-based rather than NVRAM (non-volatile random-access memory), some sectors are reserved for overhead, erase procedures, and spare sectors for long-term wear reduction.

**Obtaining a V-Switch™ Key:**

Contact EIG's inside sales staff at sales@electroind.com or by calling (516) 334-0870 (USA) and provide the following information:

1. Serial number(s) of the meter(s) you are upgrading. Use the number(s), with leading zeros, shown in the Communicator EXT™ Device Status screen (from the Communicator EXT™ Main screen, click **Tools>Device Status**).

2. Desired V-Switch™ key.

3. Credit card or Purchase Order number. EIG will issue you the V-Switch™ key.

**Enabling the V-Switch™ Key:**

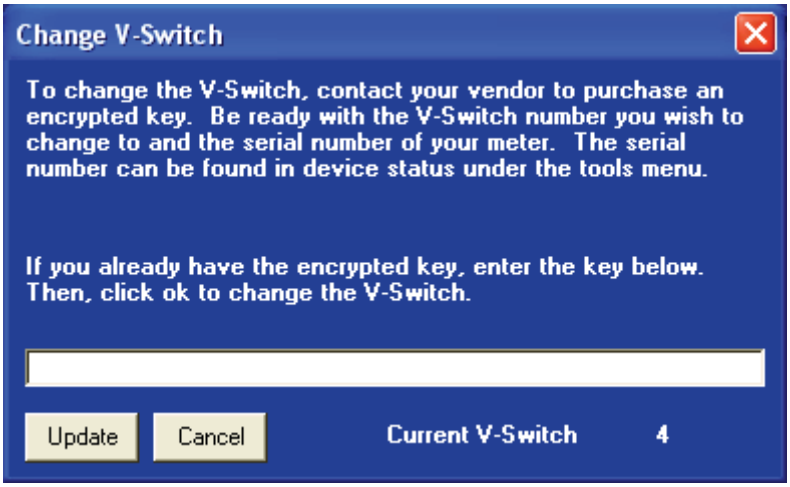
1. Open Communicator EXT™ software.

2. Power up your meter.

3. Connect to the Shark® 200 meter through Communicator EXT™ software (see Chapter 5).

4. Click **Tools>Change V-Switch** from the Title Bar. A screen opens, requesting the encrypted key. Enter the V-Switch™ key provided by EIG.

5. Click the **OK** button. The V-Switch™ key is enabled and the meter resets.


Change V-Switch
To change the V-Switch, contact your vendor to purchase an encrypted key. Be ready with the V-Switch number you wish to change to and the serial number of your meter. The serial number can be found in device status under the tools menu.
If you already have the encrypted key, enter the key below. Then, click ok to change the V-Switch.
Update
Cancel
Current V-Switch
4

**NOTE:** For more details on software configuration, refer to the Communicator EXT™ Software User's Manual.

### 2.1.4: Measured Values

The Shark® 200 meter provides the following measured values all in real time instantaneous. As the table below shows, some values are also available in average, maximum and minimum.

| Measured Values | Instantaneous | Avg | Max | Min |
|---|---|---|---|---|
| Voltage L-N | X | | X | X |
| Voltage L-L | X | | X | X |
| Current per Phase | X | X | X | X |
| Current Neutral | X | X | X | X |
| WATT(A,B,C,Tot.) | X | X | X | X |
| VAR (A,B,C,Tot.) | X | X | X | X |
| VA (A,B,C,Tot.) | X | X | X | X |
| PF (A,B,C,Tot.) | X | X | X | X |
| +Watt-Hour (A,B,C,Tot.) | X | | | |
| -Watt-Hour (A,B,C,Tot.) | X | | | |
| Watt-Hour Net | X | | | |
| +VAR-Hour (A,B,C,Tot.) | X | | | |
| -VAR-Hour (A,B,C,Tot.) | X | | | |
| VAR-Hour Net (A,B,C,Tot.) | X | | | |
| VA-Hour (A,B,C,Tot.) | X | | | |
| Frequency | X | | X | X |
| Harmonics to the 40th Order | X | | | |
| %THD | X | | X | X |
| Voltage Angles | X | | | |
| Current Angles | X | | | |
| % of Load Bar | X | | | |
| Waveform Scope | X | | | |

### 2.1.5: Utility Peak Demand

The Shark® 200 meter provides user-configured Block (Fixed) window or Rolling window Demand modes. This feature lets you set up a customized Demand profile. Block window Demand mode records the average demand for time intervals you define (usually 5, 15 or 30 minutes). Rolling window Demand mode functions like multiple, overlapping Block windows. You define the subintervals at which an average of Demand is calculated. An example of Rolling window Demand mode would be a 15-minute Demand block using 5-minute subintervals, thus providing a new Demand reading every 5 minutes, based on the last 15 minutes.

Utility Demand features can be used to calculate Watt, VAR, VA and PF readings. Voltage provides an instantaneous Max and Min reading which displays the highest surge and lowest sag seen by the meter. All other parameters offer Max and Min capability over the user-selectable averaging period.

## 2.2: Specifications

### Power Supply

| | |
|---|---|
| Range: | D2 Option: Universal, (90 to 265) VAC @50/60Hz or (100 to 370)VDC<br>D Option: (18-60) VDC |
| Power Consumption: | (5 to 10)VA, (3.5 to 7)W - depending on the meter's hardware configuration |

### Voltage Inputs

(For Accuracy specifications, see Section 2.4.)

| | |
|---|---|
| Absolute Maximum Range: | Universal, Auto-ranging:<br>Phase to Reference (Va, Vb, Vc to Vref): (20 to 576)VAC<br>Phase to Phase (Va to Vb, Vb to Vc, Vc to Va): (0 to 721)VAC |
| Supported hookups: | 3 Element Wye, 2.5 Element Wye, 2 Element Delta, 4 Wire Delta |
| Input Impedance: | 1M Ohm/Phase |
| Burden: | 0.36VA/Phase Max at 600 Volts;<br>0.014VA at 120 Volts |
| Pickup Voltage: | 20VAC |
| Connection: | 7 Pin 0.400" Pluggable Terminal Block |

| | |
|---|---|
| | AWG#12 -26/ (0.129 -3.31) $mm^2$ |
| Fault Withstand: | Meets IEEE C37.90.1 |
| Reading: | Programmable Full Scale to any PT ratio |

**Current Inputs**

(For Accuracy specifications, see Section 2.4.)

| | |
|---|---|
| Class 10: | 5A Nominal, 10A Maximum |
| Class 2: | 1A Nominal, 2A Maximum |
| Burden: | 0.005VA Per Phase Max at 11 Amps |
| Pickup Current: | 0.1% of Nominal (0.2% of Nominal if using Current Only mode, that is, there is no connection to the Voltage inputs) |
| Connections: | O Lug or U Lug electrical connection (Figure 4.1)<br>Pass through wire, 0.177” / 4.5mm maximum diameter (Figure 4.2)<br>Quick connect, 0.25” male tab (Figure 4.3) |
| Fault Withstand (at $23^o$ C): | 100A/10sec., 300A/3sec., 500A/1sec. |
| Reading: | Programmable Full Scale to any CT ratio |

| | |
|---|---|
| Continuous Current Withstand: | 20 Amps for screw terminated or pass through connections |

**KYZ/RS485 Port Specifications**

RS485 Transceiver; meets or exceeds EIA/TIA-485 Standard

| | |
|---|---|
| Type: | Two-wire, half duplex |
| Min. input Impedance: | 96kΩ |
| Max. output current: | ±60mA |

**Wh Pulse**

KYZ output contacts, and infrared LED light pulses through face plate (see Section 6.4 for Kh values):

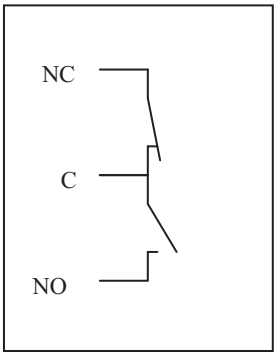
| | |
|---|---|
| Pulse Width: | 90ms |
| Full Scale Frequency: | ~3Hz |
| Contact type: | Solid state – SPDT (NO – C – NC) |
| Relay type: | Solid state |
| Peak switching voltage: | DC ±350V |
| Continuous load current: | 120mA |
| Peak load current: | 350mA for 10ms |
| On resistance, max.: | 35Ω |
| Leakage current: | 1μA@350V |
| Isolation: | AC 3750V |
| Reset state: | (NC - C) Closed; (NO - C) Open |

Infrared LED:

Peak Spectral wavelength: 940nm

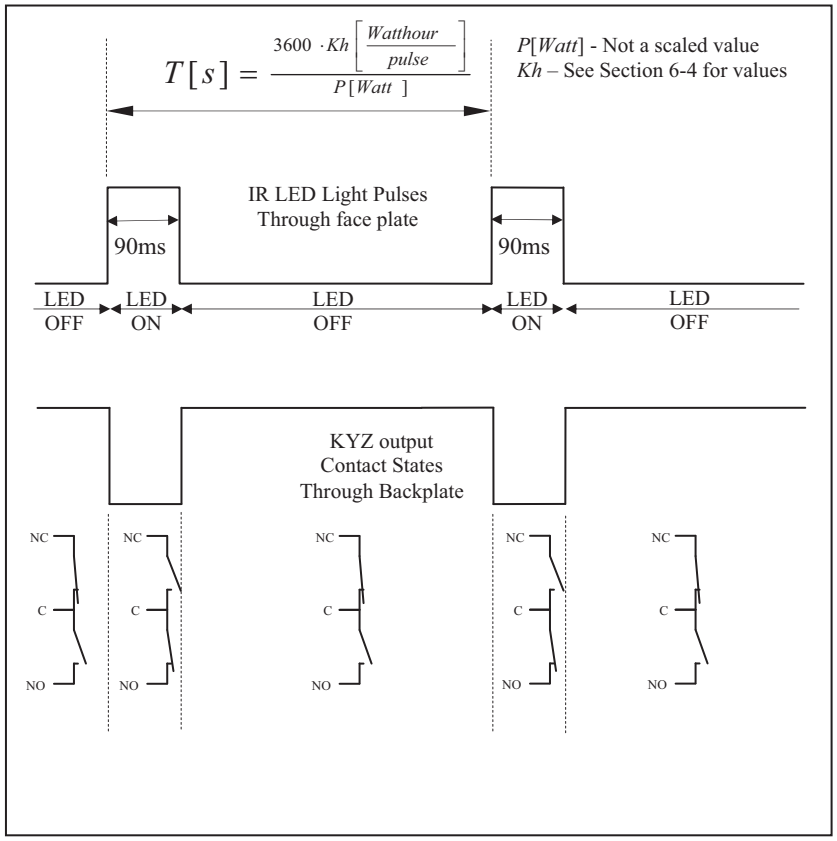
Reset state: Off

**Internal schematic:**




(De-energized state)

**Output timing:**



**Isolation**

All Inputs and Outputs are galvanically isolated to 2500 VAC

**Environmental Rating**

| | |
|---|---|
| Storage: | (-20 to +70)$^{o}$ C |
| Operating: | (-20 to +70)$^{o}$ C |
| Humidity: | to 95% RH Non-condensing |
| Faceplate Rating: | NEMA12 (Water Resistant), mounting gasket included |

**Measurement Methods**

| | |
|---|---|
| Voltage, current: | True RMS |
| Power: | Sampling at over 400 samples per cycle on all channels |

**Update Rate**

| | |
|---|---|
| Watts, VAR and VA: | Every 6 cycles (e.g., 100ms @ 60 Hz) |
| All other parameters: | Every 60 cycles (e.g., 1 s @ 60 Hz) 1 second for Current Only measurement, if reference Voltage is not available |

**Communication**

Standard:

1. RS485 port through backplate
2. IrDA port through faceplate
3. Energy pulse output through backplate and Infrared LED through faceplate

Optional, through I/O card slots:

1. INP100S - 10/100BaseT Ethernet card

2. FOSTS - Fiber Optic output ST terminated card

3. FOVPS - Fiber Optic output Versatile Link terminated card

| | |
|---|---|
| Protocols: | Modbus RTU, Modbus ASCII, DNP 3.0 |
| Com Port Baud Rate: | RS485 Only: 1200, 2400, 4800*; All Com Ports: 9600 to 57600 bps |
| Com Port Address: | 001-247 |
| Data Format: | 8 Bit, No Parity (RS485: also Even or Odd Parity*) |
| Shark® 200T transducer | Default Initial communication baud rate 9600 (See Chapter 5) |

**Mechanical Parameters**

Dimensions: see Chapter 3.

| | |
|---|---|
| Weight (without Option card): | 2 pounds/ 0.9kg (ships in a 6” /15.24cm cube container) |

*With Runtime Firmware Version 26 or higher

## 2.3: Compliance

- UL Listing: USL/CNL E250818
- CE (EN61326-1, FCC Part 15, Subpart B, Class A)
- IEC 62053-22 (0.2% Class)
- ANSI C12.20 (0.2% Accuracy)
- ANSI (IEEE) C37.90.1 Surge Withstand
- ANSI C62.41 (Burst)

- EN61000-6-2 Immunity for Industrial Environments: 2005
- EN61000-6-4 Emission Standards for Industrial Environments: 2007
- EN61326 EMC Requirements: 2006

## 2.4: Accuracy

(For full Range specifications see Section 2.2.)

Shark 200 Clock Accuracy: Max. +/-2 seconds per day at 25° C

For 23° C, 3 Phase balanced Wye or Delta load, at 50 or 60 Hz (as per order), 5A (Class 10) nominal unit, accuracy as follows:

| Parameter | Accuracy | Accuracy Input Range1 |
|---|---|---|
| Voltage L-N [V] | 0.1% of reading | (69 to 480)V |
| Voltage L-L [V] | 0.2% of reading [2] | (120 to 600)V |
| Current Phase [A] | 0.1% of reading [1, 3] | (0.15 to 5) A |
| Current Neutral (calculated) [A] | 2% of Full Scale [1] | (0.15 to 5) A @ (45 to 65) Hz |
| Active Power Total [W] | 0.2% of reading [1, 2] | (0.15 to 5) A @ (69 to 480) V @ +/- (0.5 to 1) lag/lead PF |
| Active Energy Total [Wh] | 0.2% of reading [1, 2] | (0.15 to 5) A @ (69 to 480) V @ +/- (0.5 to 1) lag/lead PF |
| Reactive Power Total [VAR] | 0.2% of reading [1, 2] | (0.15 to 5) A @ (69 to 480) V @ +/- (0 to 0.8) lag/lead PF |
| Reactive Energy Total [VARh] | 0.2% of reading [1, 2] | (0.15 to 5) A @ (69 to 480) V @ +/- (0 to 0.8) lag/lead PF |
| Apparent Power Total [VA] | 0.2% of reading [1, 2] | (0.15 to 5) A @ (69 to 480) V @ +/- (0.5 to 1) lag/lead PF |
| Apparent Energy Total [VAh] | 0.2% of reading [1, 2] | (0.15 to 5) A @ (69 to 480) V @ +/- (0.5 to 1) lag/lead PF |

| Parameter | Accuracy | Accuracy Input Range1 |
|---|---|---|
| Power Factor | 0.2% of reading [1, 2] | (0.15 to 5) A @ (69 to 480) V @ +/- (0.5 to 1) lag/lead PF |
| Frequency [Hz] | +/- 0.001 Hz | (45 to 65) Hz |
| Total Harmonic Distortion [%] | +/- 2% [1, 4] | (0.5 to 10)A or (69 to 480)V, measurement range (1 to 99.99)% |
| Load Bar | +/- 1 segment[1] | (0.005 to 6) A |

**1**

- For 2.5 element programmed units, degrade accuracy by an additional 0.5% of reading.
- For 1A (Class 2) Nominal, degrade accuracy to 0.5% of reading for watts and energy; all other values 2 times rated accuracy.
- For 1A (Class 2) Nominal, the input current range for accuracy specification is 20% of the values listed in the table.

**2**

For unbalanced Voltage inputs where at least one crosses the 150V auto-scale threshold (for example, 120V/120V/208V system), degrade the accuracy to 0.4% of reading.

**3**

With reference Voltage applied (VA, VB, or VC). Otherwise, degrade accuracy to 0.2%. See hookup diagrams 8, 9, and 10 in Chapter 4.

**4**

At least one Voltage input (minimum 20 VAC) must be connected for THD measurement on current channels.

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# 3: Mechanical Installation

## 3.1: Introduction

The Shark® 200 meter can be installed using a standard ANSI C39.1 (4" round) or an IEC 92mm DIN (square) form. In new installations, simply use existing DIN or ANSI punches. For existing panels, pull out old analog meters and replace them with the Shark® 200 meter. See Section 3.4 for Shark® 200T transducer installation. See Chapter 4 for wiring diagrams.

**NOTE:** The drawings shown below and on the next page give you the meter dimensions in inches and centimeters [cm shown in brackets]. Tolerance is +/- 0.1" [.25 cm].

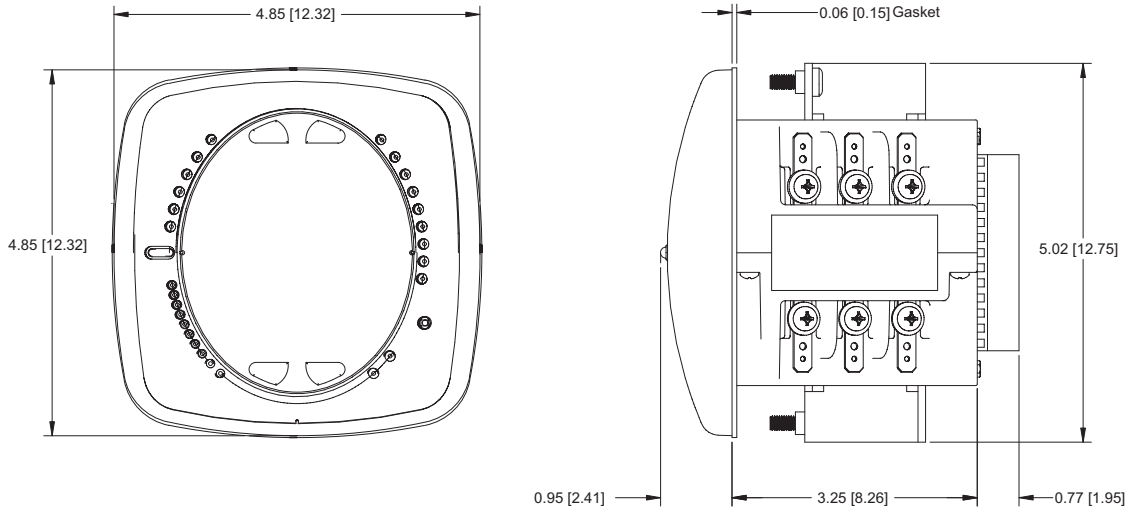


Figure 3.1: Meter Front and Side Dimensions

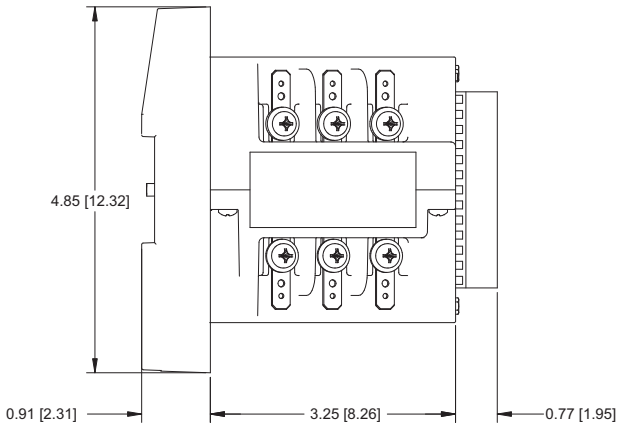


Figure 3.2: Shark® 200T Dimensions

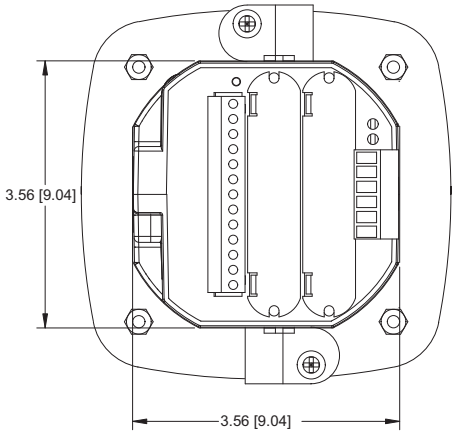


Figure 3.3: Meter Back Dimensions

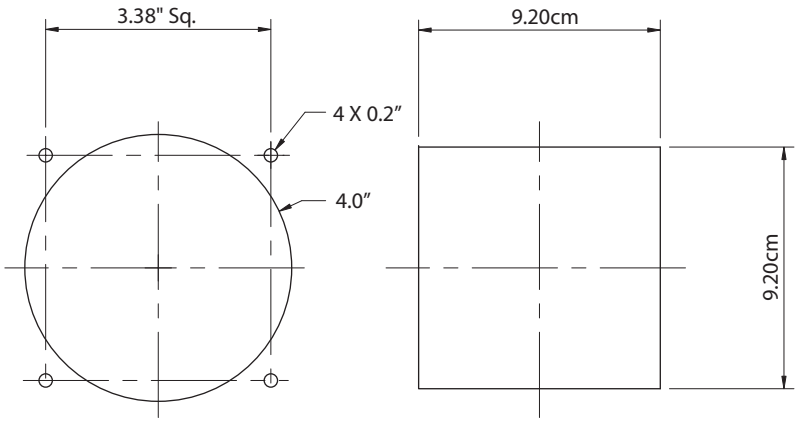


Figure 3.4: ANSI and DIN Cutout Dimensions

Recommended Tools for Shark® 200 Meter Installation:

- #2 Phillips screwdriver
- Small adjustable wrench
- Wire cutters

The Shark® 200 meter is designed to withstand harsh environmental conditions; however it is recommended you install it in a dry location, free from dirt and corrosive substances (see Environmental specifications in Chapter 2).

## 3.2: ANSI Installation Steps

1. Slide meter with Mounting Gasket into panel.

2. Secure from back of panel with flat washer, lock washer and nut on each threaded rod. Use a small wrench to tighten. Do not overtighten. The maximum installation torque is 0.4 Newton-Meter.

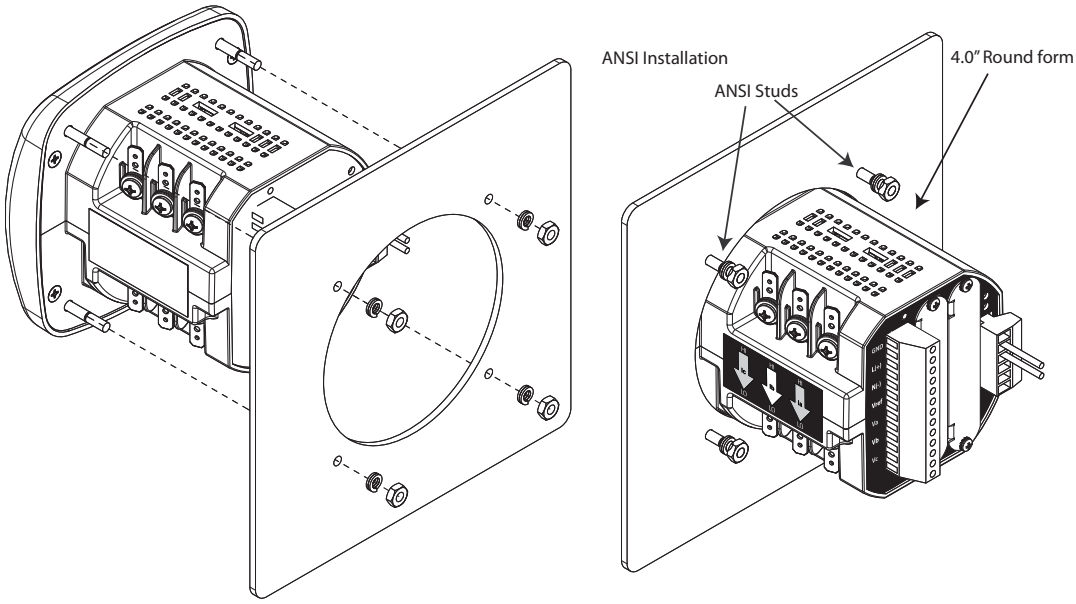


Figure 3.5: ANSI Installation

## 3.3: DIN Installation Steps

1. Slide meter with NEMA 12 Mounting Gasket into panel (remove ANSI Studs, if in place).

2. From back of panel, slide 2 DIN Mounting Brackets into grooves in top and bottom of meter housing. Snap into place.

3. Secure meter to panel by using a #2 Phillips screwdriver to tighten the screw on each of the two mounting brackets. Do not overtighten: the maximum installation torque is 0.4 Newton-Meter.

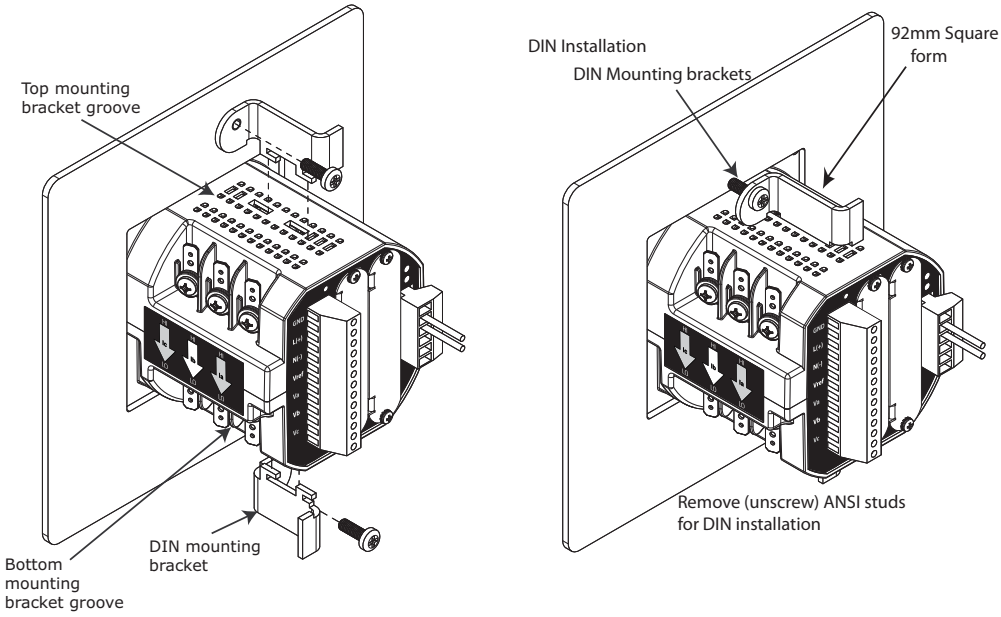


Figure 3.6: DIN Installation

## 3.4: Transducer Installation

Use DIN Rail mounting to install the Shark® 200T transducer.

**Specs for DIN Rail Mounting**

International Standards DIN 46277/3

**DIN Rail (Slotted) Dimensions**

0.297244" x 1.377953" x 3" /.755cm x 3.5cm x 7.62cm

1. Slide top groove of meter onto the DIN Rail.

2. Press gently until the meter clicks into place.

**NOTES:**

- To remove the meter from the DIN Rail, pull down on the Release Clip to detach the unit from the rail (see Figure 3.7).
- If mounting with the DIN Rail provided, use the black rubber stoppers, also provided (see Figure 3.8).

**NOTE ON DIN RAILS:** DIN Rails are commonly used as a mounting channel for most terminal blocks, control devices, circuit protection devices and PLCs. DIN Rails are made of electrolytically plated cold rolled steel and are also available in aluminum, PVC, stainless steel and copper.

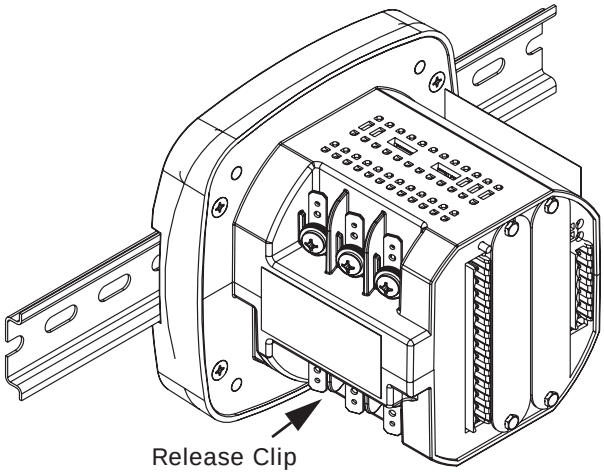


Figure 3.7: Transducer on DIN Rail

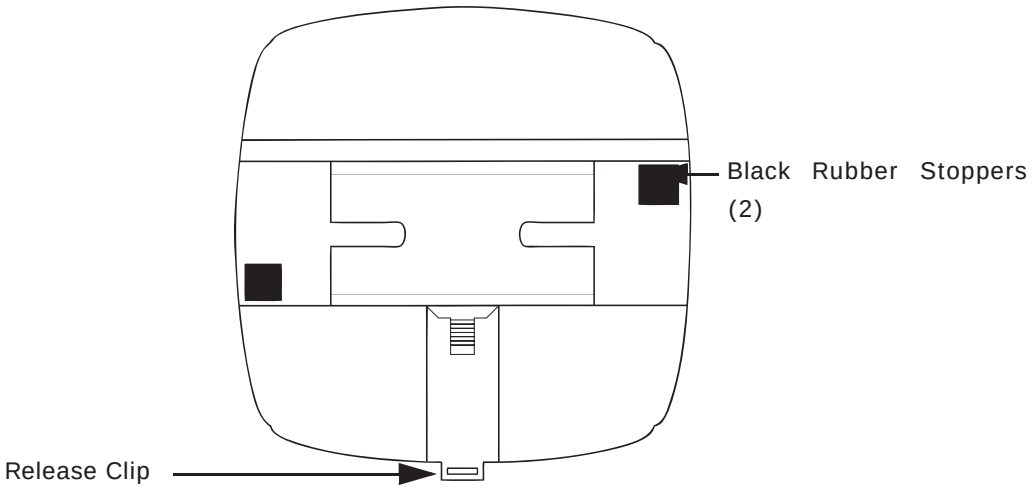


Figure 3.8: DIN Rail Detail

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# 4: Electrical Installation

## 4.1: Considerations When Installing Meters

Installation of the Shark® 200 meter must be performed only by qualified personnel who follow standard safety precautions during all procedures. Those personnel should have appropriate training and experience with high Voltage devices. Appropriate safety gloves, safety glasses and protective clothing is recommended.

During normal operation of the Shark® 200 meter, dangerous Voltages flow through many parts of the meter, including: Terminals and any connected CTs (Current Transformers) and PTs (Potential Transformers), all I/O Modules (Inputs and Outputs) and their circuits.

All Primary and Secondary circuits can, at times, produce lethal Voltages and currents. Avoid contact with any current-carrying surfaces.

**Do not use the meter or any I/O Output device for primary protection or in an energy-limiting capacity. The meter can only be used as secondary protection.**

Do not use the meter for applications where failure of the meter may cause harm or death.

Do not use the meter for any application where there may be a risk of fire.

All meter terminals should be inaccessible after installation.

Do not apply more than the maximum Voltage the meter or any attached device can withstand. Refer to meter and/or device labels and to the specifications for all devices before applying voltages. Do not HIPOT/Dielectric test any Outputs, Inputs or Communications terminals.

EIG recommends the use of Fuses for Voltage leads and power supply and shorting blocks to prevent hazardous Voltage conditions or damage to CTs, if the meter needs to be removed from service. CT grounding is optional.

**IMPORTANT!**

**IF THE EQUIPMENT IS USED IN A MANNER NOT SPECIFIED BY THE MANUFACTURER, THE PROTECTION PROVIDED BY THE EQUIPMENT MAY BE IMPAIRED.**

- THERE IS NO REQUIRED PREVENTIVE MAINTENANCE OR INSPECTION NECESSARY FOR SAFETY. HOWEVER, ANY REPAIR OR MAINTENANCE SHOULD BE PERFORMED BY THE FACTORY.

DISCONNECT DEVICE: The following part is considered the equipment disconnect device. A SWITCH OR CIRCUIT-BREAKER SHALL BE INCLUDED IN THE END-USE EQUIPMENT OR BUILDING INSTALLATION. THE SWITCH SHALL BE IN CLOSE PROXIMITY TO THE EQUIPMENT AND WITHIN EASY REACH OF THE OPERATOR. THE SWITCH SHALL BE MARKED AS THE DISCONNECTING DEVICE FOR THE EQUIPMENT.

## 4.2: CT Leads Terminated to Meter

The Shark® 200 meter is designed to have current inputs wired in one of three ways. Figure 4.1 shows the most typical connection where CT Leads are terminated to the meter at the current gills. This connection uses nickel-plated brass studs (current gills) with screws at each end. This connection allows the CT wires to be terminated using either an "O" or a "U" lug.Tighten the screws with a #2 Phillips screwdriver. The maximum installation torque is 1 Newton-Meter.

Other current connections are shown in figures 4.2 and 4.3. Voltage and RS485/KYZ connections are shown in Figure 4.4.

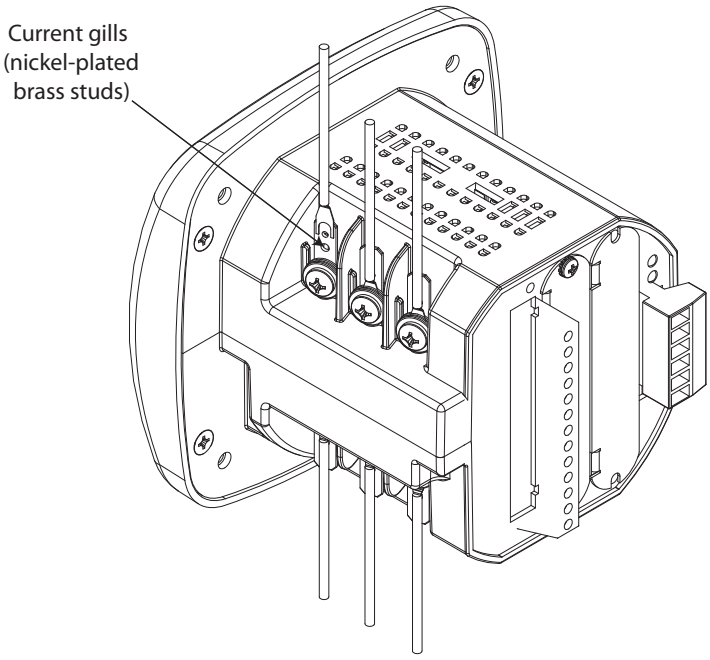



Figure 4.1: CT Leads Terminated to Meter, #8 Screw for Lug Connection

Wiring Diagrams are shown in Section 4.8 of this chapter.

Communications connections are detailed in Chapter 5.

## 4.3: CT Leads Pass Through (No Meter Termination)

The second method allows the CT wires to pass through the CT inputs without terminating at the meter. In this case, remove the current gills and place the CT wire directly through the CT opening. The opening accommodates up to 0.177” / 4.5mm maximum diameter CT wire.

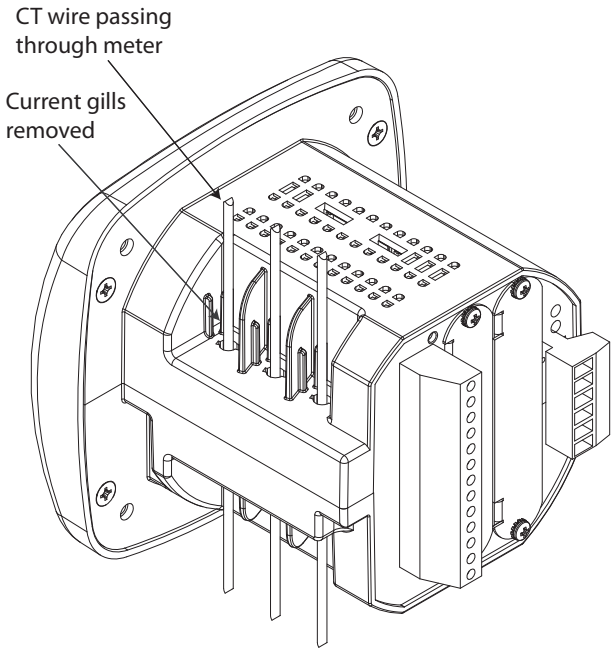



Figure 4.2: Pass Through Wire Electrical Connection

## 4.4: Quick Connect Crimp-on Terminations

For quick termination or for portable applications, 0.25” quick connect crimp-on connectors can also be used

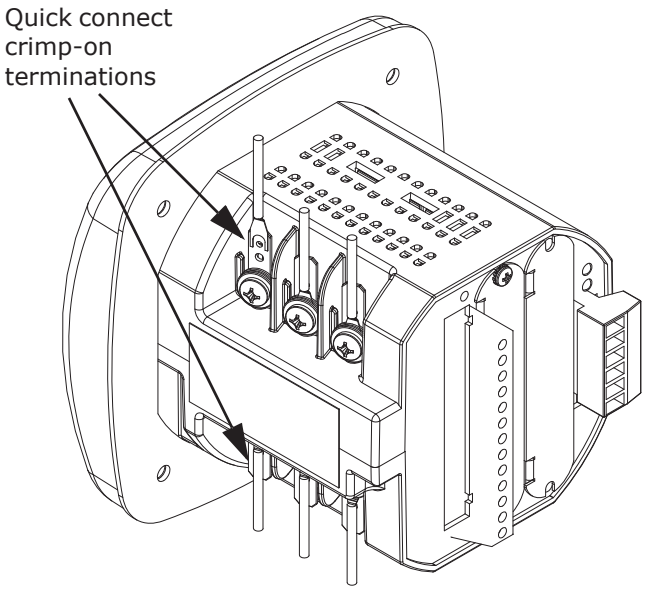



Figure 4.3: Quick Connect Electrical Connection

## 4.5: Voltage and Power Supply Connections

Voltage inputs are connected to the back ofthe unit via optional wire connectors. The connectors accommodate AWG# 12 -26/ (0.129 - 3.31)mm$^2$.

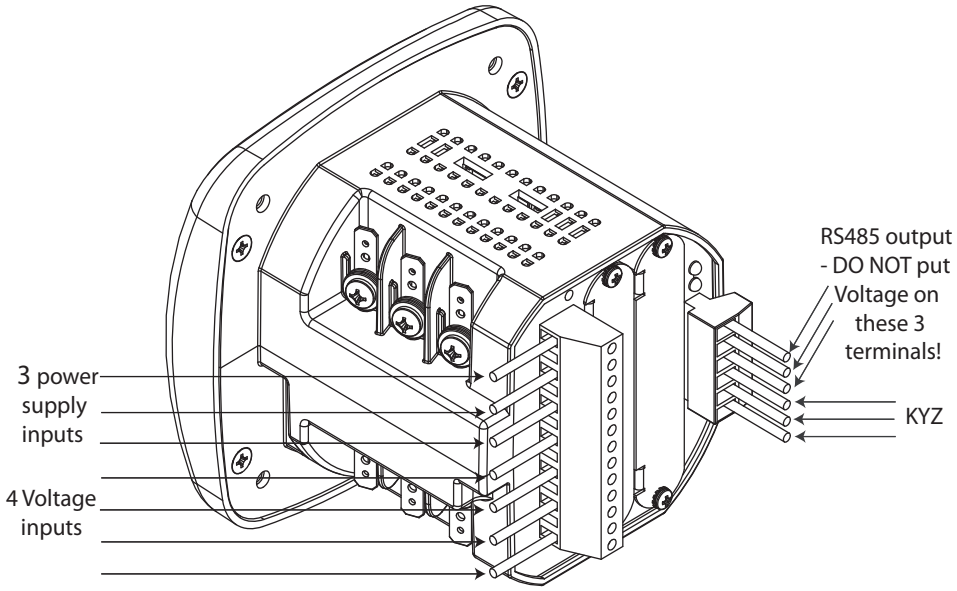



Figure 4.4: Meter Connections

## 4.6: Ground Connections

The meter's Ground terminals should be connected directly to the installation's protective earth ground. Use AWG# 12/2.5 mm$^2$ wire for this connection.

## 4.7: Voltage Fuses

EIG recommends the use of fuses on each of the sense voltages and on the control power, even though the wiring diagrams in this chapter do not show them.

- Use a 0.1 Amp fuse on each voltage input.
- Use a 3 Amp Slow Blow fuse on the power supply.

EIG offers the EI-CP Panel meter protective fuse kit, which can be ordered from EIG's webstore: www.electroind.com/store. Select Fuse Kits from the list on the left side of the webpage.

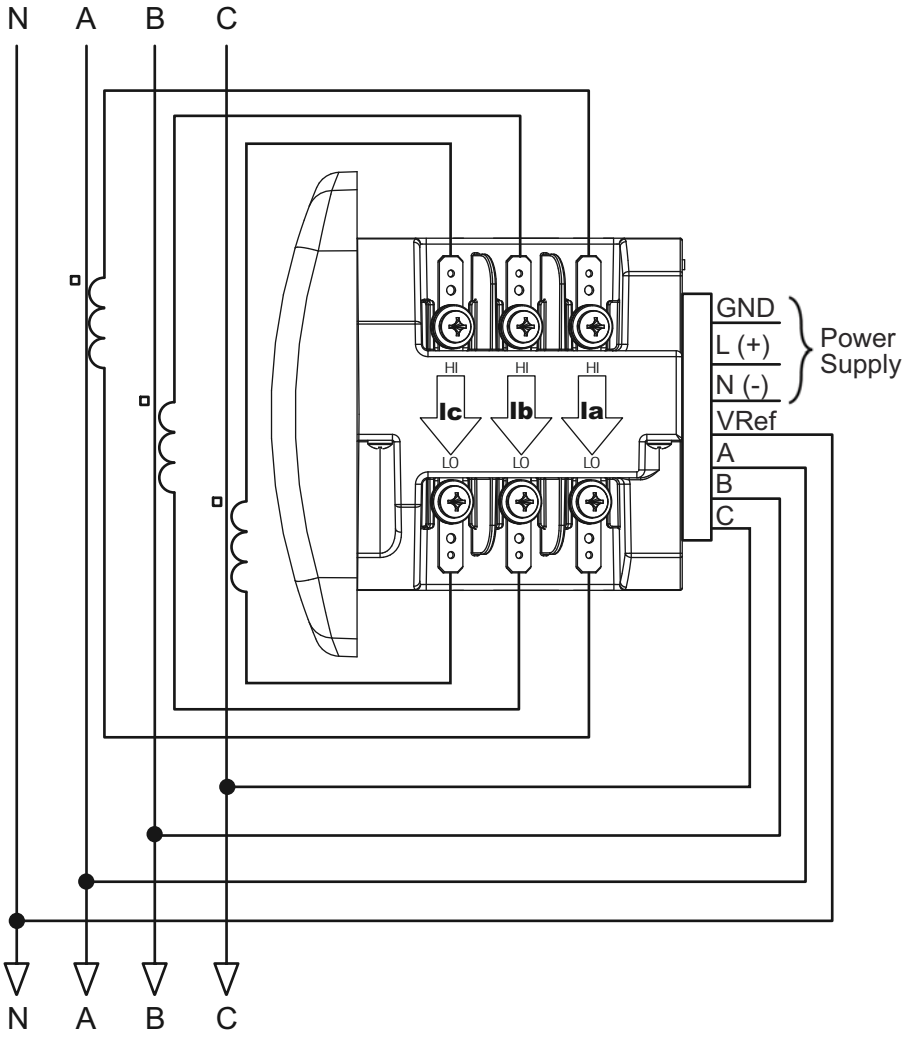
## 4.8: Electrical Connection Diagrams

The following pages contain electrical connection diagrams for the Shark® 200 meter. Choose the diagram that best suits your application. Be sure to maintain the CT polarity when wiring.

The diagrams are presented in the following order:

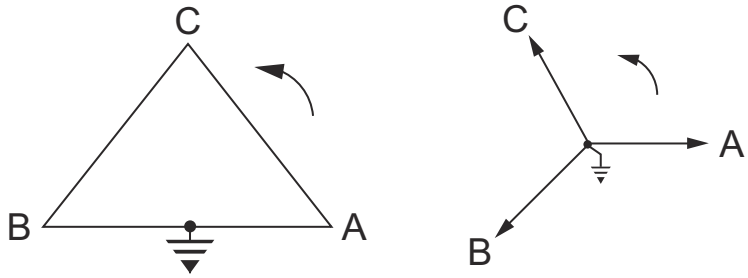
1. Three Phase, Four-Wire System Wye/Delta with Direct Voltage, 3 Element
   a. Example of Dual-Phase Hookup
   b. Example of Single Phase Hookup
2. Three Phase, Four-Wire System Wye with Direct Voltage, 2.5 Element
3. Three-Phase, Four-Wire Wye/Delta with PTs, 3 Element
4. Three-Phase, Four-Wire Wye with PTs, 2.5 Element
5. Three-Phase, Three-Wire Delta with Direct Voltage
6. Three-Phase, Three-Wire Delta with 2 PTs, 2 CTs
7. Three-Phase, Three-Wire Delta with 2 PTs, 3 CTs
8. Current Only Measurement (Three Phase)
9. Current Only Measurement (Dual Phase)
10. Current Only Measurement (Single Phase)

### 1. Service: WYE/Delta, 4-Wire with No PTs, 3 CTs

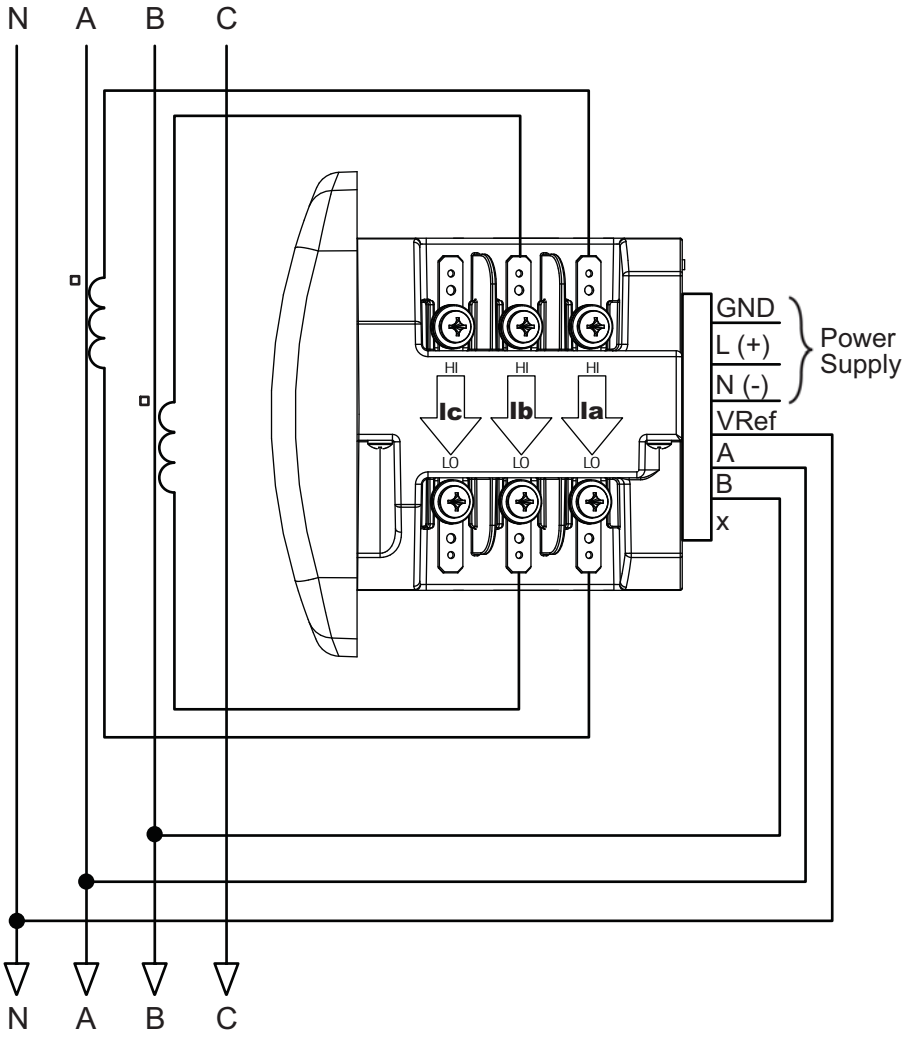



Select: " 3 EL WYE " (3 Element Wye) from the Shark® meter's front panel display (see Chapter 6).

**NOTE:** The grounding point for the CTs is not shown and not required for the meter to work properly, but we do recommend grounding the CTs to reduce shock hazard.



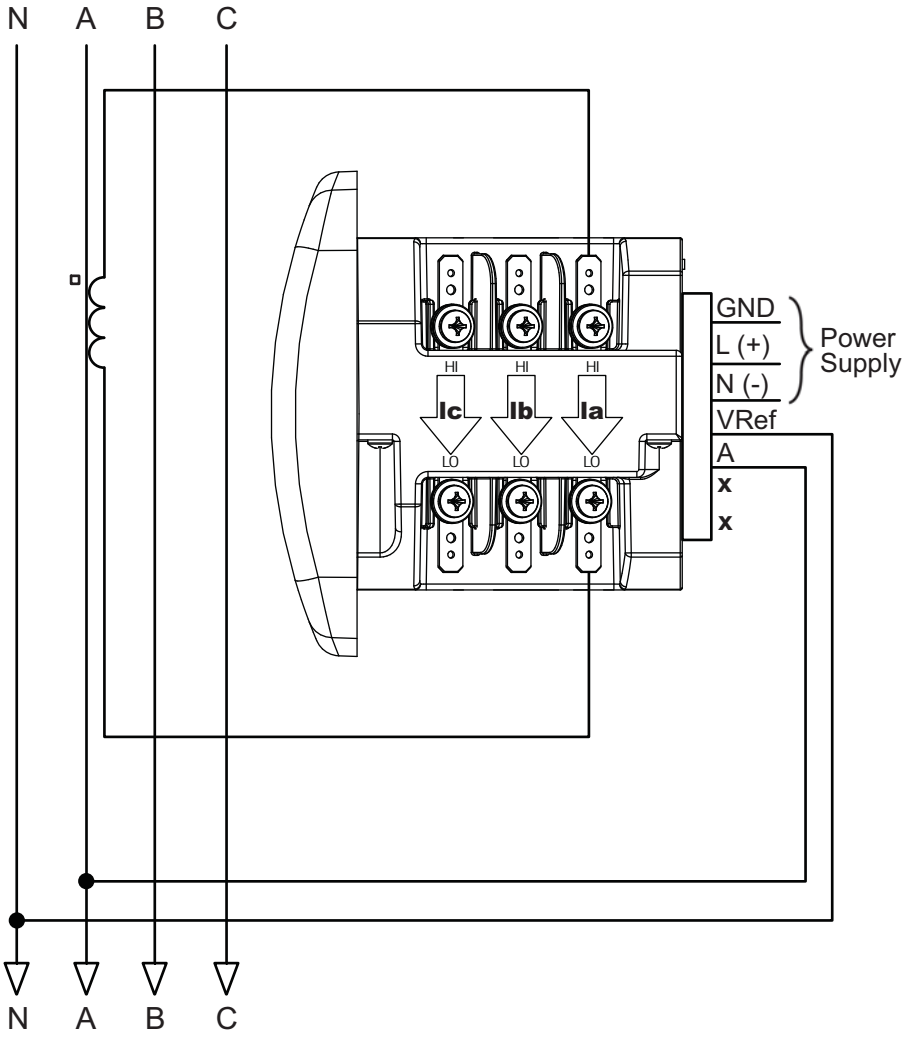
### 1a. Example of Dual Phase Hookup




Select: " 3 EL WYE " (3 Element Wye) from the Shark® meter's Front Panel Display. (See Chapter 6.)

**NOTE:** The grounding point for the CTs is not shown and not required for the meter to work properly, but we do recommend grounding the CTs to reduce shock hazard.

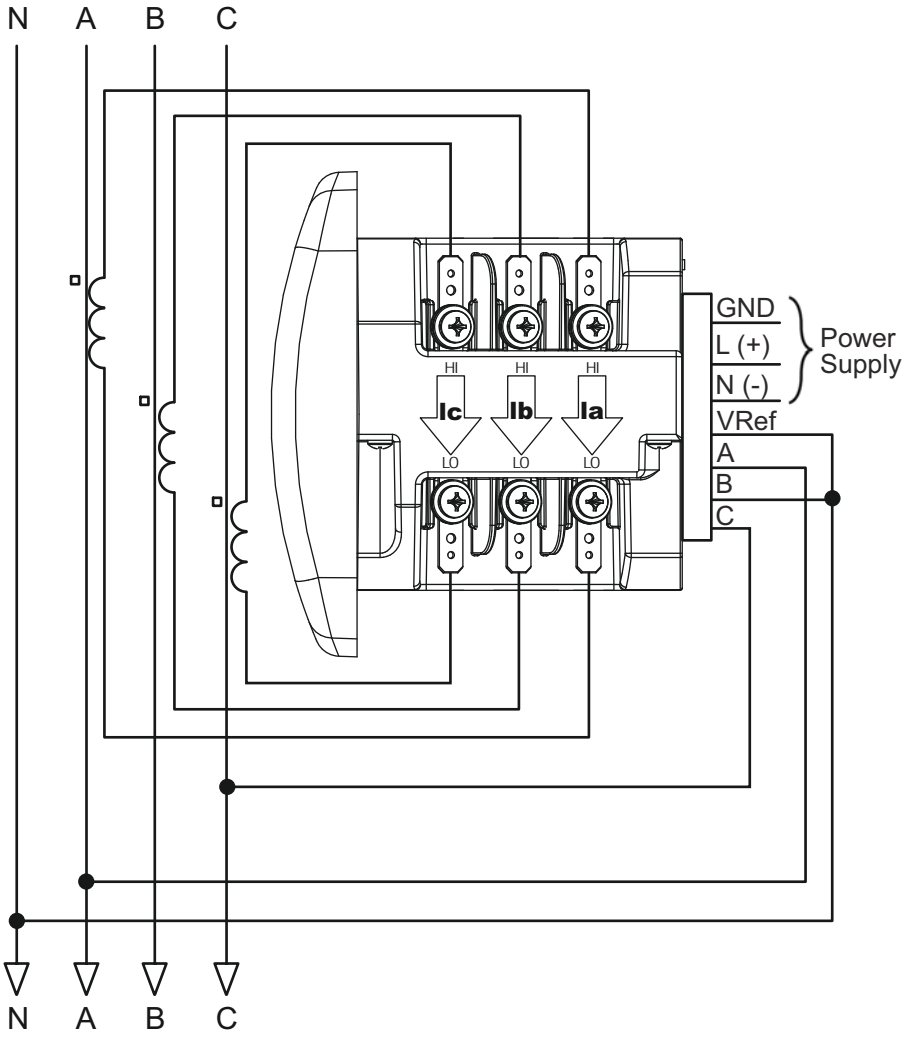
### 1b. Example of Single Phase Hookup




Select: " 3 EL WYE " (3 Element Wye) from the Shark® meter's Front Panel Display. (See Chapter 6.)

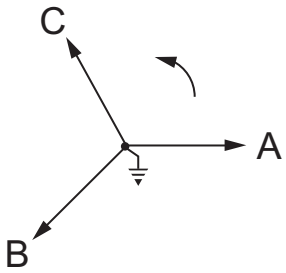
**NOTE:** The grounding point for the CTs is not shown and not required for the meter to work properly, but we do recommend grounding the CTs to reduce shock hazard.

**2. Service: 2.5 Element WYE, 4-Wire with No PTs, 3 CTs**

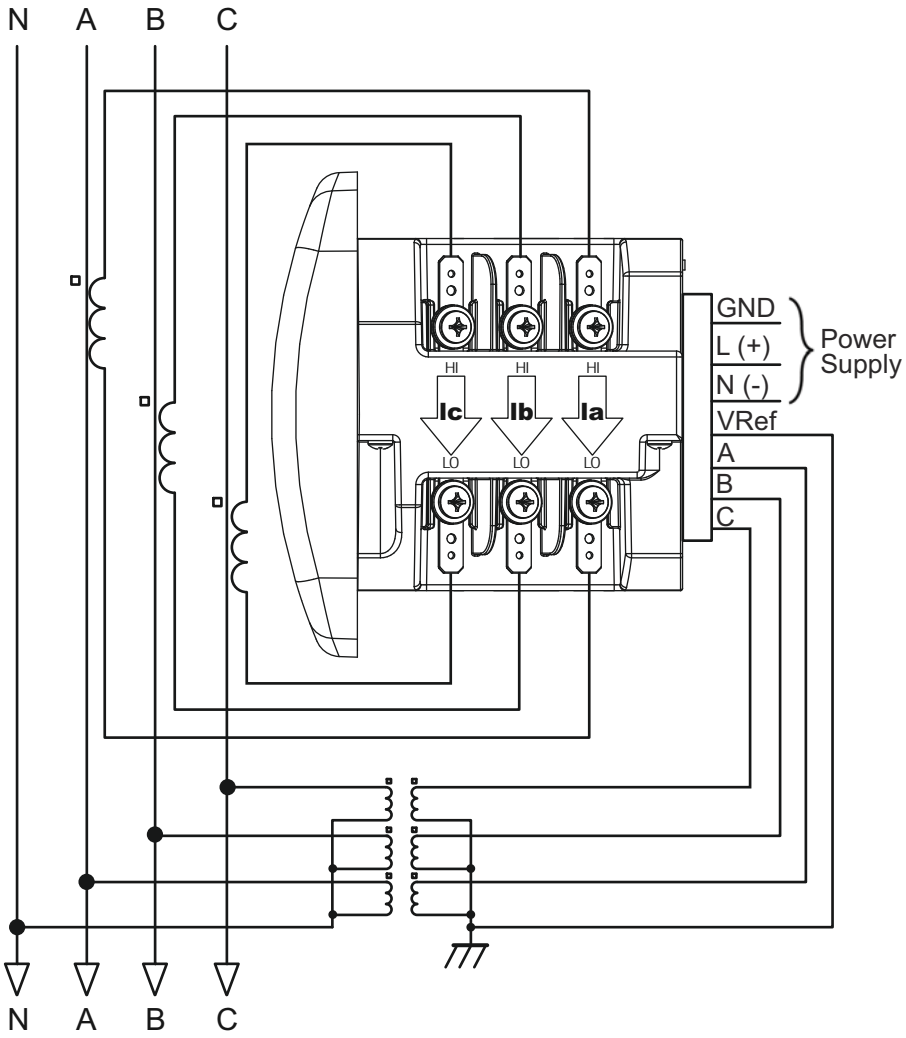



Select: "2.5 EL WYE" (2.5 Element Wye) from the Shark® meter's front panel display (see Chapter 6).

**NOTE:** The grounding point for the CTs is not shown and not required for the meter to work properly, but we do recommend grounding the CTs to reduce shock hazard.

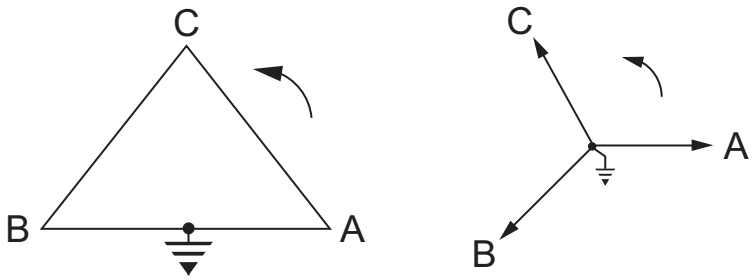


### 3. Service: WYE/Delta, 4-Wire with 3 PTs, 3 CTs

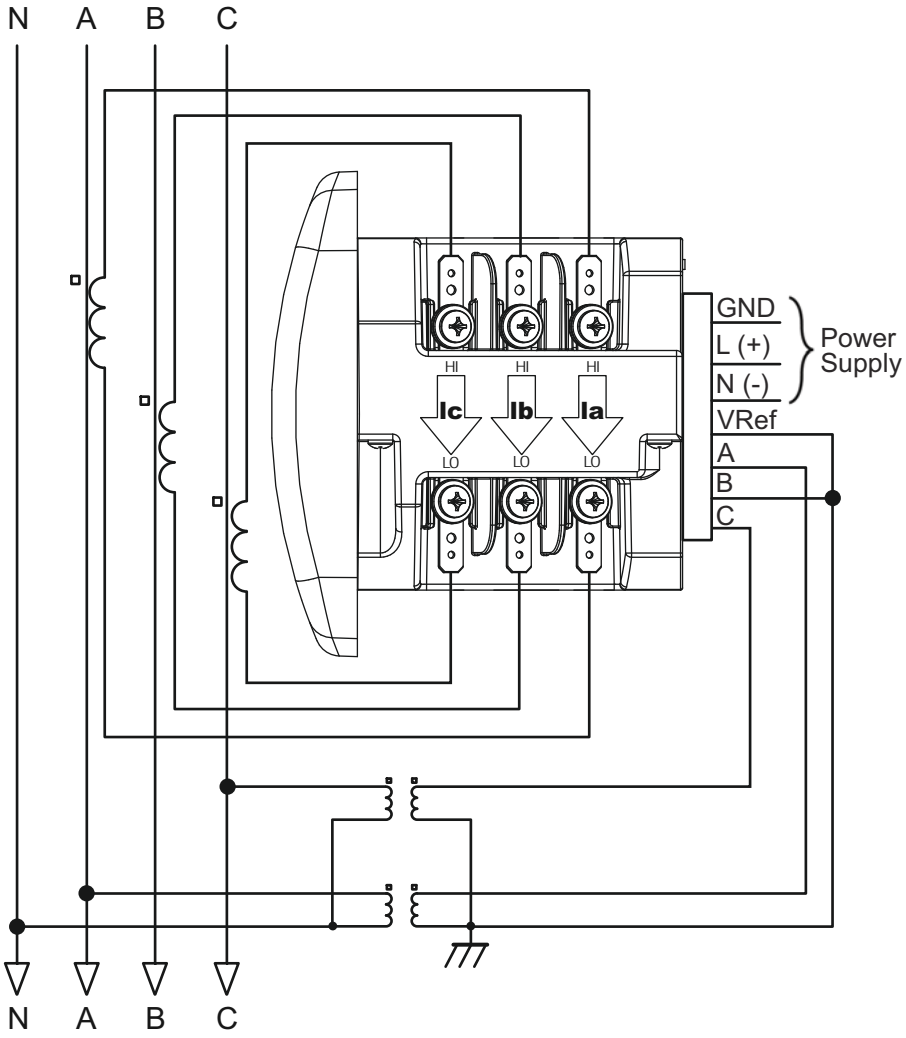



Select: "3 EL WYE" (3 Element Wye) from the Shark® meter's front panel display (see Chapter 6).

**NOTE:** The grounding point for the CTs is not shown and not required for the meter to work properly, but we do recommend grounding the CTs to reduce shock hazard.

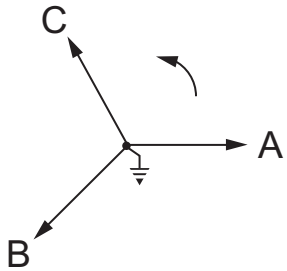


**4. Service: 2.5 Element WYE, 4-Wire with 2 PTs, 3 CTs**

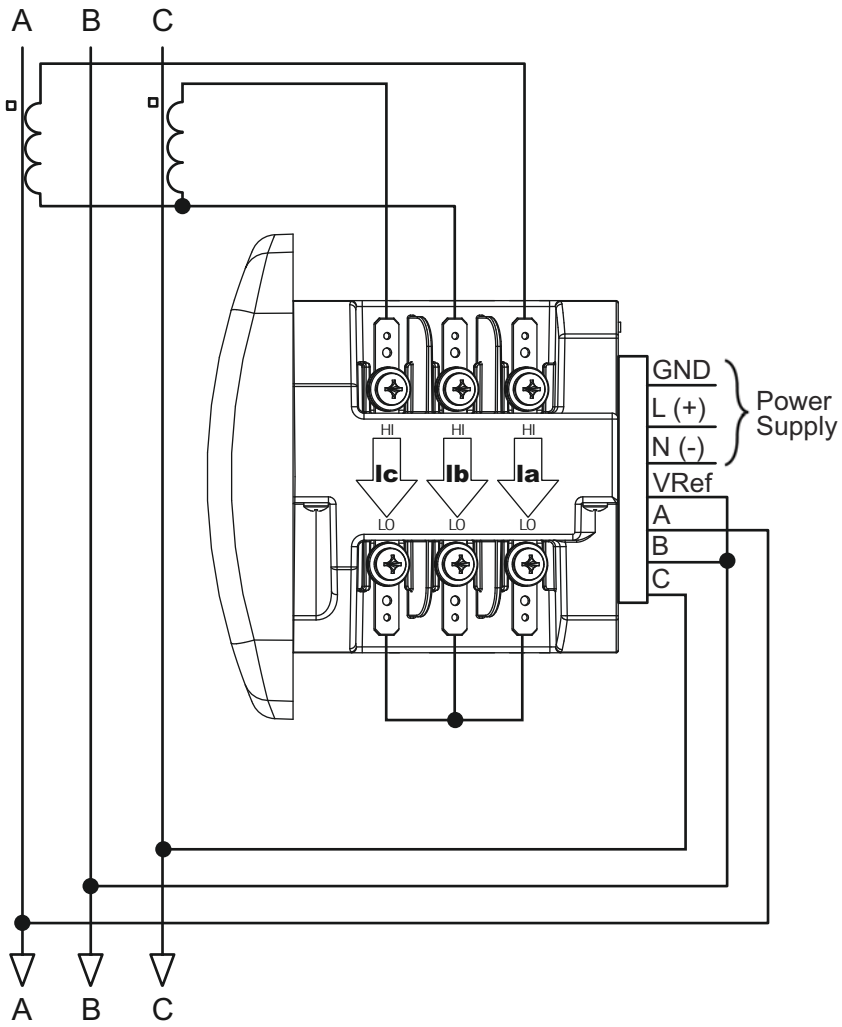



Select: "2.5 EL WYE" (2.5 Element Wye) from the Shark® meter's front panel display (see Chapter 6).

**NOTE:** The grounding point for the CTs is not shown and not required for the meter to work properly, but we do recommend grounding the CTs to reduce shock hazard.

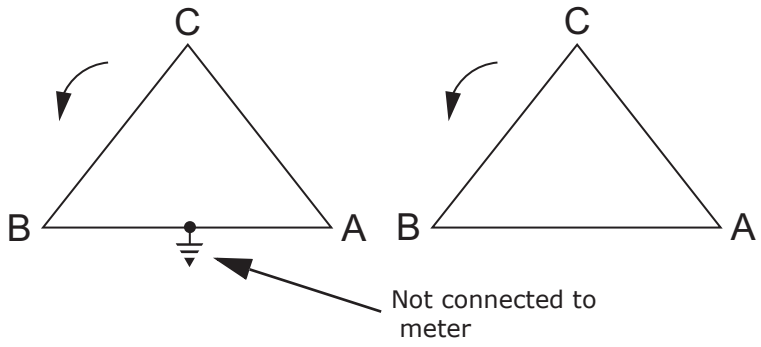


### 5. Service: Delta, 3-Wire with No PTs, 2 CTs

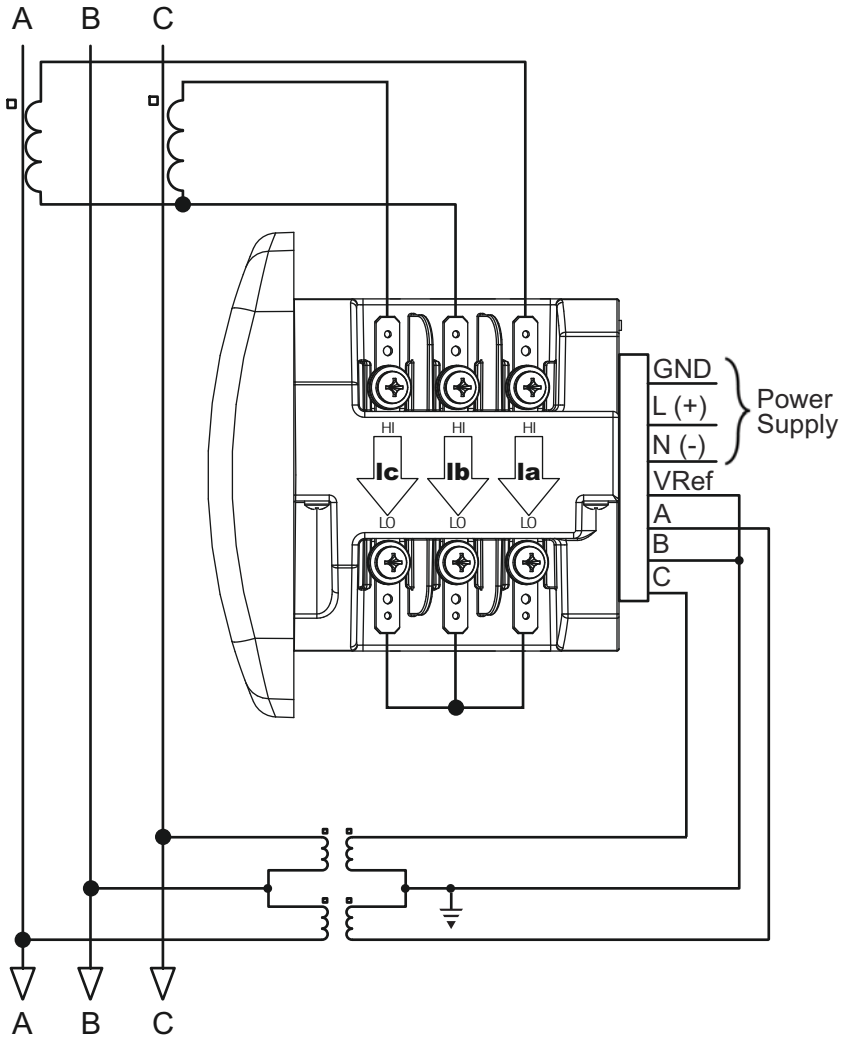



Select: "2 CT DEL" (2 CT Delta) from the Shark® meter's front panel display (see Chapter 6).

**NOTE:** The grounding point for the CTs is not shown and not required for the meter to work properly, but we do recommend grounding the CTs to reduce shock hazard.

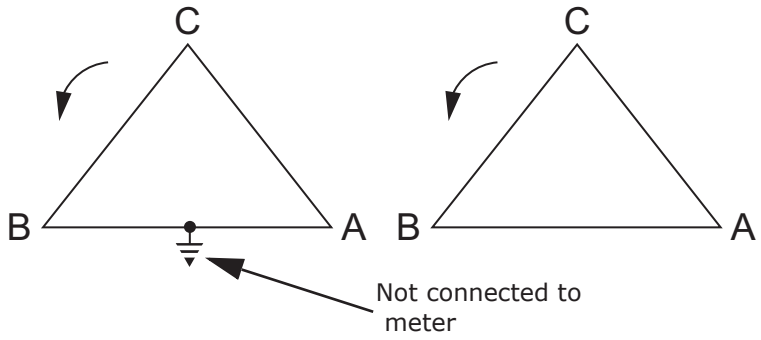


### 6. Service: Delta, 3-Wire with 2 PTs, 2 CTs

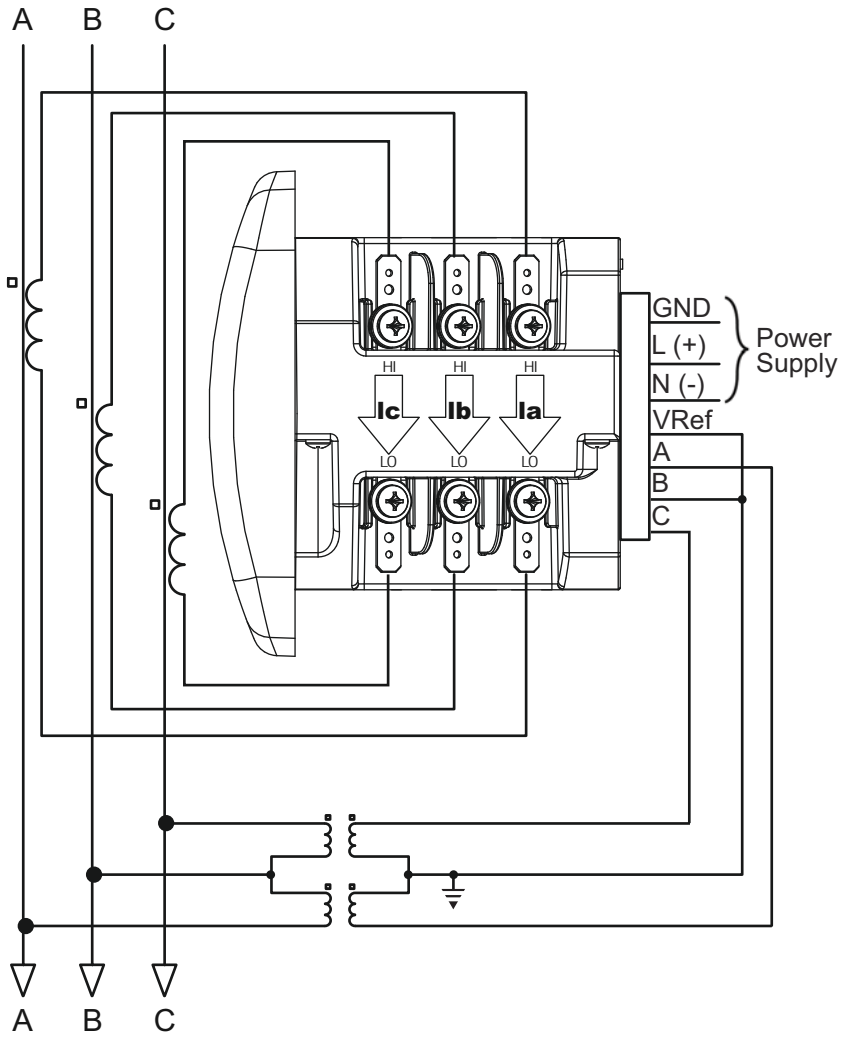



Select: "2 CT DEL" (2 CT Delta) from the Shark® meter's front panel display (see Chapter 6).

**NOTE:** The grounding point for the CTs is not shown and not required for the meter to work properly, but we do recommend grounding the CTs to reduce shock hazard.



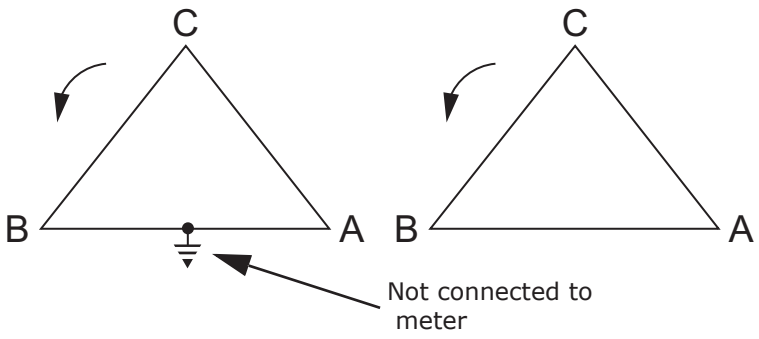
### 7. Service: Delta, 3-Wire with 2 PTs, 3 CTs



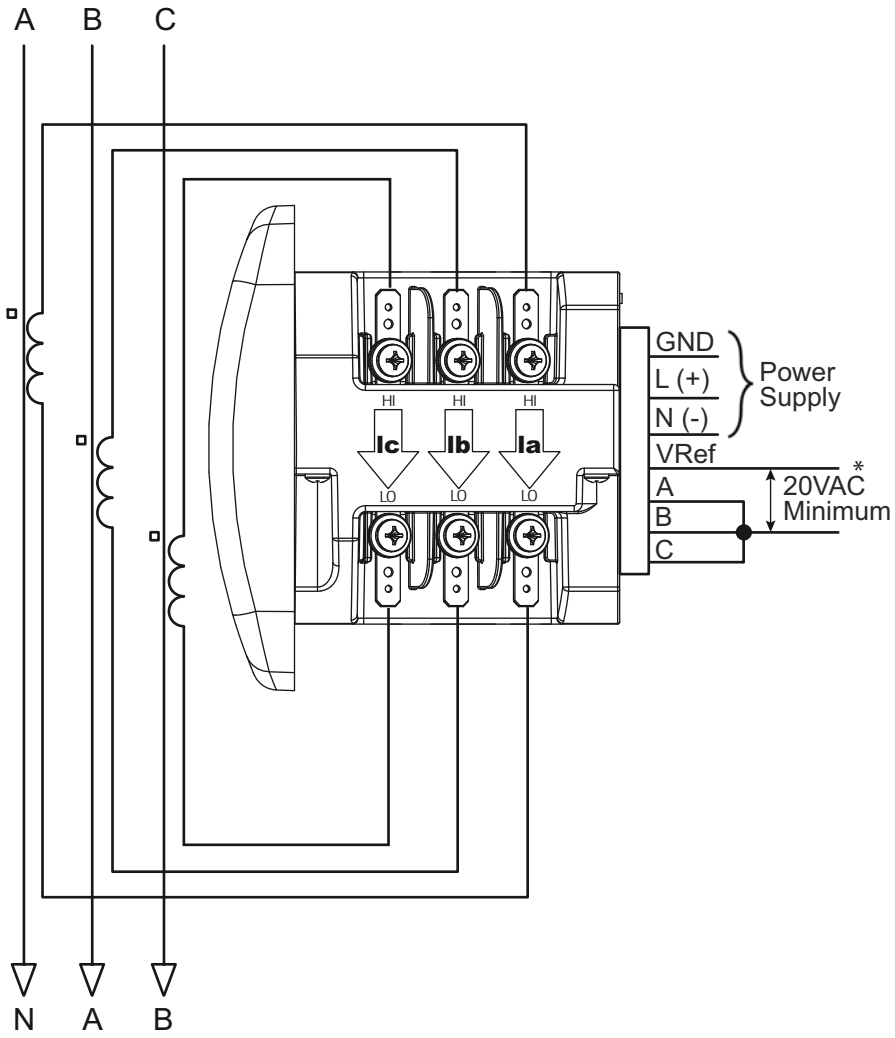

Select: "2 CT DEL" (2 CT Delta) from the Shark® meter's front panel display (see Chapter 6).

**NOTES:**

- The third CT for hookup is optional, and is used only for Current measurement.
- The grounding point for the CTs is not shown and not required for the meter to work properly, but we do recommend grounding the CTs to reduce shock hazard.


C
B
A
C
B
A
Not connected to
meter

### 8. Service: Current Only Measurement (Three Phase)

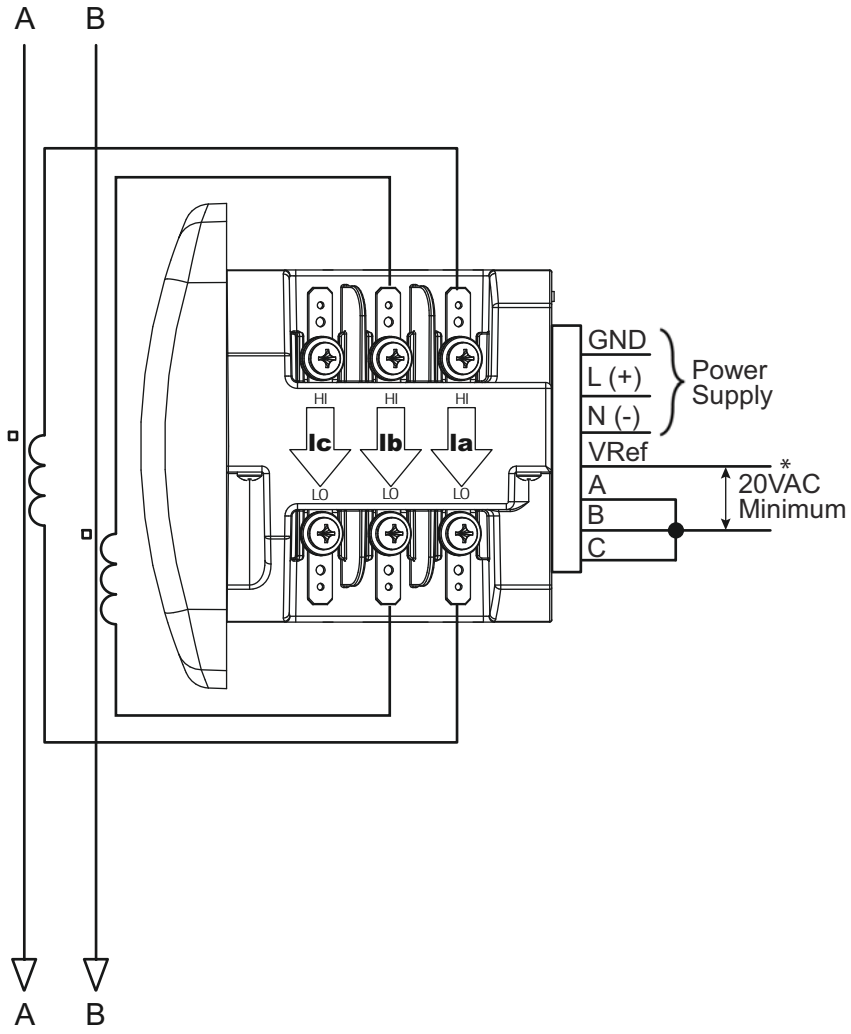



Select: "3 EL WYE" (3 Element Wye) from the Shark® meter's front panel display (see Chapter 6.)

***** This connection is not required, but is recommended for improved accuracy.

**NOTE:** The grounding point for the CTs is not shown and not required for the meter to work properly, but we do recommend grounding the CTs to reduce shock hazard.

### 9. Service: Current Only Measurement (Dual Phase)

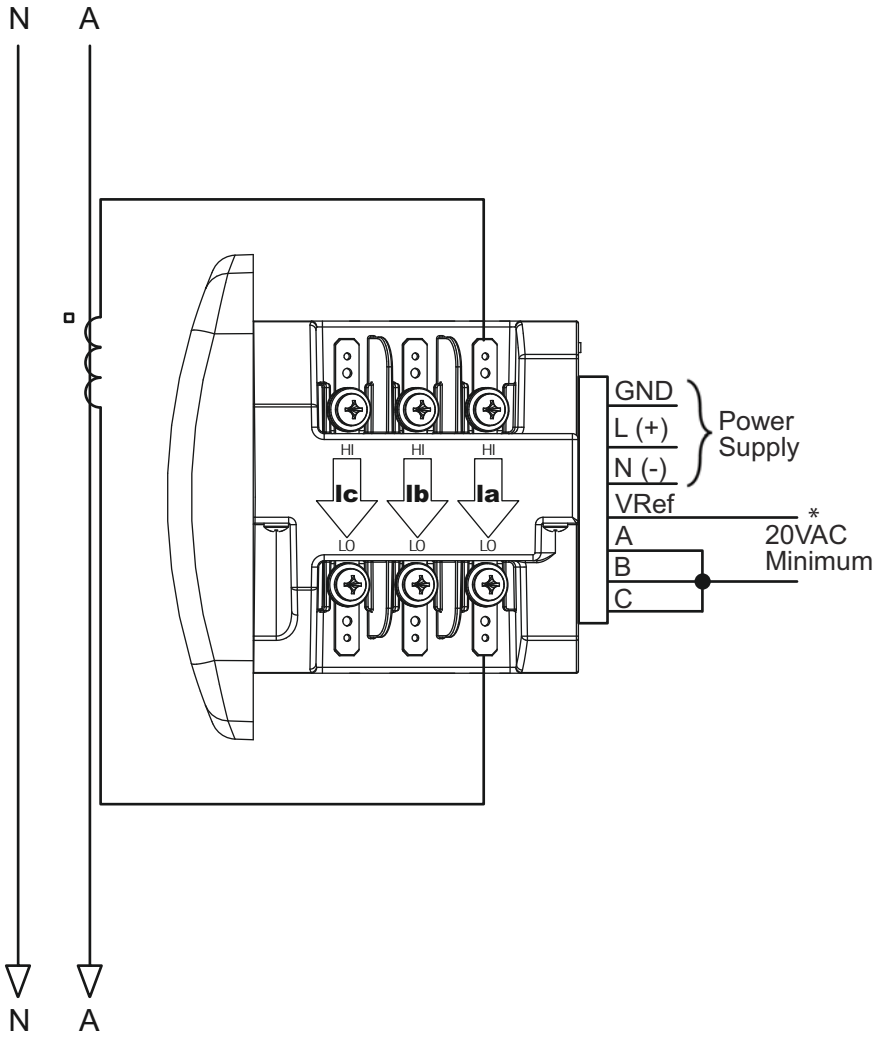



Select: "3 EL WYE" (3 Element Wye) from the Shark® meter's front panel display (see Chapter 6).

***** This connection is not required, but is recommended for improved accuracy.

**NOTE:** The grounding point for the CTs is not shown and not required for the meter to work properly, but we do recommend grounding the CTs to reduce shock hazard.

### 10. Service: Current Only Measurement (Single Phase)




Select: "3 EL WYE" (3 Element Wye) from the Shark® meter's front panel display (see Chapter 6).

***** This connection is not required, but is recommended for improved accuracy.

**NOTES:**

- The grounding point for the CTs is not shown and not required for the meter to work properly, but we do recommend grounding the CTs to reduce shock hazard.
- The diagram shows a connection to Phase A, but you can also connect to Phase B or Phase C.

# 5: Communication Installation

## 5.1: Shark® 200 Meter Communication

The Shark® 200 meter provides two independent Communication ports. The first port, Com 1, is an optical IrDA port. The second port, Com 2, provides RS485 communication speaking Modbus ASCII, Modbus RTU, and DNP 3.0 protocols. Additionally, the Shark® 200 meter has optional communication cards: the Fiber Optic communication card and the 10/100BaseT Ethernet communication card. See chapters 7 and 8 for more information on these options.

### 5.1.1: IrDA Port (Com 1)

The Shark® 200 meter's Com 1 IrDA port is on the face of the meter. The IrDA port allows the unit to be read and programmed without the need of a communication cable. Just point at the meter with an IrDA-equipped laptop PC to configure it.

**NOTES:**

- Settings for Com 1 (IrDA Port) are configured using Communicator EXT™ software.
- This port only communicates via Modbus ASCII Protocol.
- Refer to Appendix D for instructions on using EIG's USB to IrDA Adapter.

### 5.1.2: RS485 / KYZ Output (Com 2)

Com 2 provides a combination RS485 and an Energy Pulse Output (KYZ pulse).

See Chapter 2, Section 2.2 for the KYZ Output specifications; see Chapter 6, Section 6.4 for pulse constants.

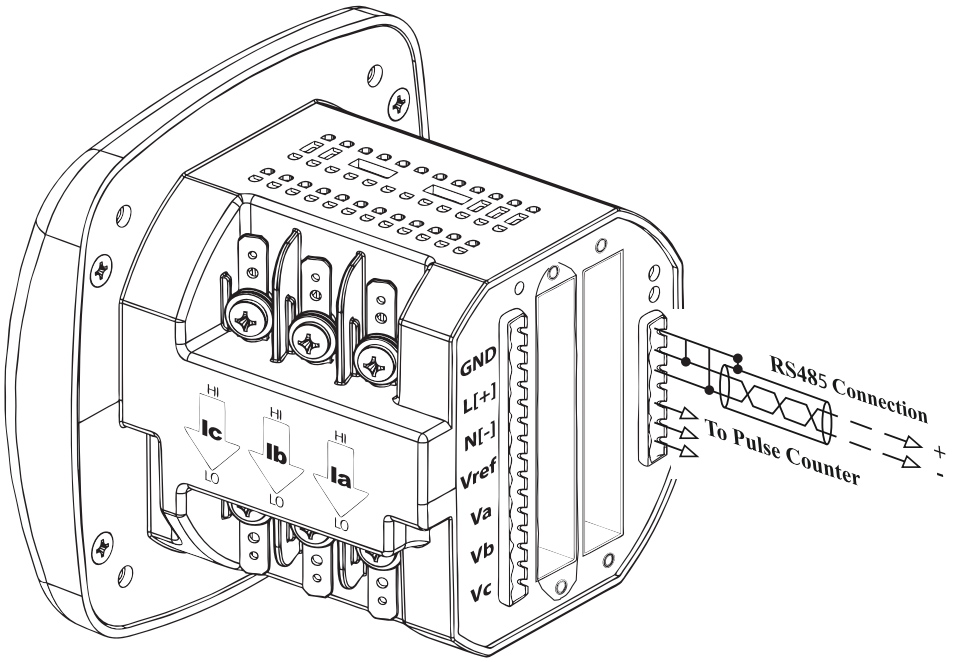



Figure 5.1: Shark® 200 Meter Back with RS485 Communication Installation

RS485 allows you to connect one or multiple Shark® 200 meters to a PC or other device, at either a local or remote site. All RS485 connections are viable for up to 4000 feet (1219.20 meters).

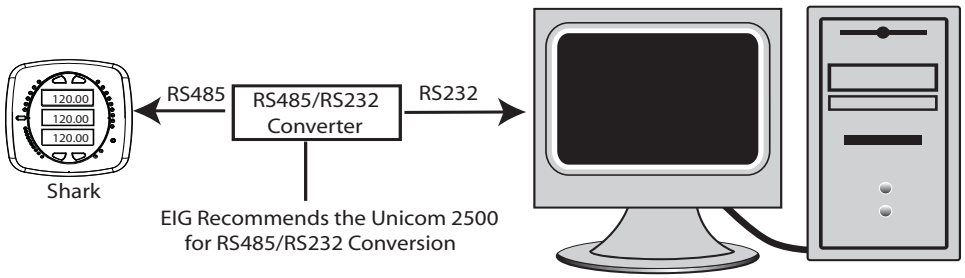



Figure 5.2: Shark® 200 Meter Connected to a PC via RS485 bus

As shown in Figure 5.2, to connect a Shark® 200 meter to a PC, you need to use an RS485 to RS232 converter, such as EIG's Unicom 2500. See Section 5.1.2.1 for information on using the Unicom 2500 with the Shark® 200 meter.

Figure 5.3 shows the detail of a 2-wire RS485 connection

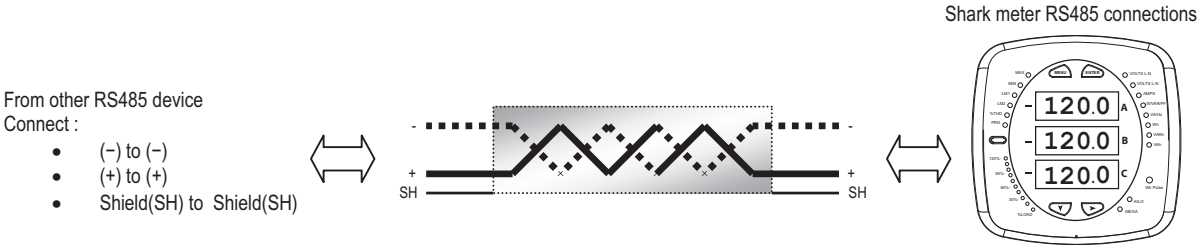



Figure 5.3: 2-wire RS485 Connection

**NOTES:**

For All RS485 Connections:

- Use a shielded twisted pair cable and ground the shield, preferably at one location only.
- Establish point-to-point configurations for each device on a RS485 bus: connect (+) terminals to (+) terminals; connect (-) terminals to (-) terminals.
- You may connect up to 31 meters on a single bus using RS485. Before assembling the bus, each meter must have a unique address: refer to Chapter 5 in the *Communicator EXT*™ *User Manual* for instructions.
- Protect cables from sources of electrical noise.
- Avoid both “Star” and “Tee” connections (see Figure 5.5).
- No more than two cables should be connected at any one point on an RS485 network, whether the connections are for devices, converters, or terminal strips.
- Include all segments when calculating the total cable length of a network. If you are not using an RS485 repeater, the maximum length for cable connecting all devices is 4000 feet (1219.20 meters).
- Connect shield to RS485 Master and individual devices as shown in Figure 5.4. You may also connect the shield to earth-ground at one point.
- Termination Resistors (RT) may be needed on both ends for longer length transmission lines. However, since the meter has some level of termination internally,

Termination Resistors may not be needed. When they are used, the value of the Termination Resistors is determined by the electrical parameters of the cable.

Figure 5.4 shows a representation of an RS485 Daisy Chain connection. Refer to Section 5.1.2.1 for details on RS485 connection for the Unicom 2500.

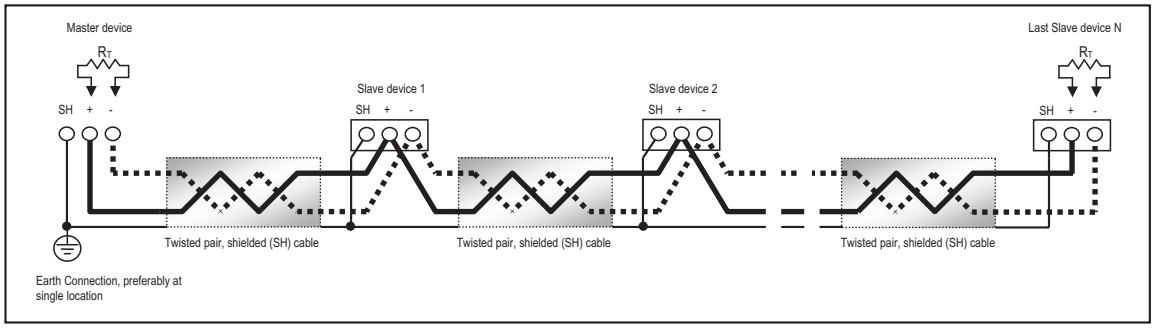

Master device
Slave device 1
Slave device 2
Last Slave device N
SH + -
Twisted pair, shielded (SH) cable
Twisted pair, shielded (SH) cable
Twisted pair, shielded (SH) cable
Earth Connection, preferably at single location

Figure 5.4: RS485 Daisy Chain Connection

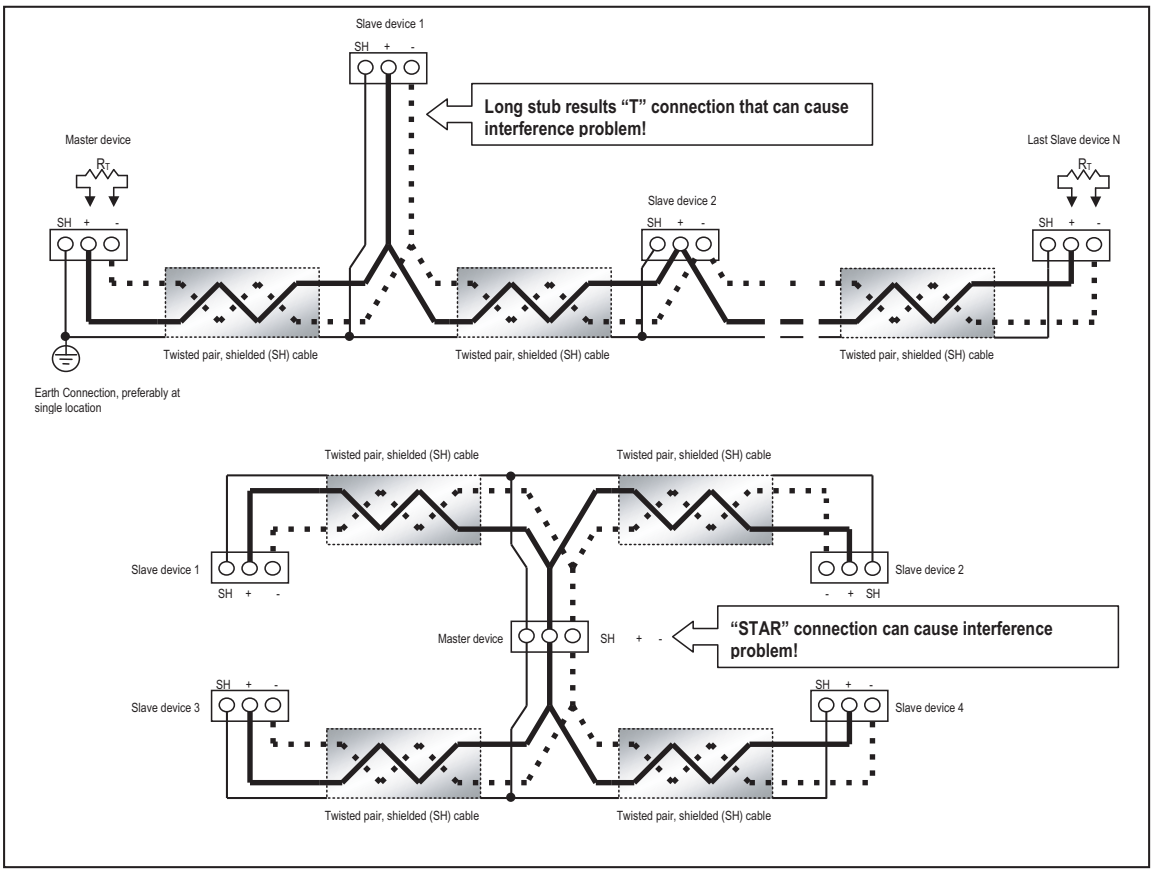

Slave device 1
Long stub results "T" connection that can cause interference problem!
Master device
Slave device 2
Last Slave device N
Twisted pair, shielded (SH) cable
Twisted pair, shielded (SH) cable
Twisted pair, shielded (SH) cable
Earth Connection, preferably at single location
Slave device 1
Slave device 2
Master device
"STAR" connection can cause interference problem!
Slave device 3
Slave device 4

Figure 5.5: Incorrect "T" and "Star" Topologies

### 5.1.2.1: Using the Unicom 2500

The Unicom 2500 provides RS485/RS232 and Fiber Optic/RS232 conversion. In doing so it allows a Shark® 200 meter with either RS485 communication or the optional Fiber Optic communication card to communicate with a PC. See the *Unicom 2500 Installation and Operation Manual* for additional information. **You can order the Unicom 2500 and the recommended communication cable for it from EIG's webstore: www.electroind.com/store.** From the left side of the webpage, select Communication Products for the Unicom 2500 and Cables and Accessories for the RS485 4-wire to 2-wire cable. Figure 5.6 illustrates the Unicom 2500 connections for RS485 and Fiber Optics.

**NOTE: We recommend you use EIG's 4-wire to 2-wire communication cable so you do not have to use jumper wires.**

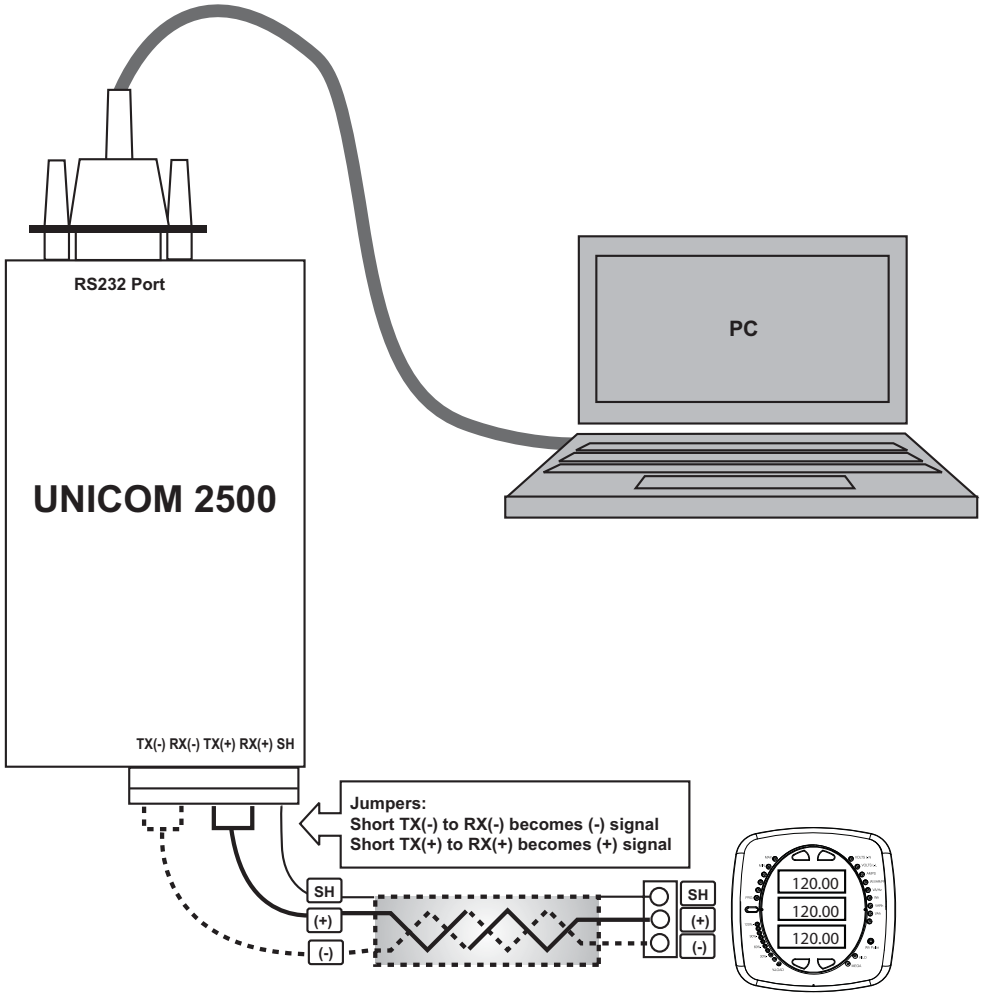
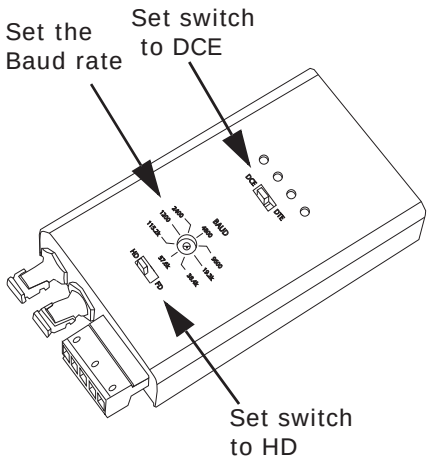



Figure 5.6: Unicom 2500 with Connections




The Unicom 2500 can be configured for either 4-wire or 2-wire RS485 connections. Since the Shark® 200 meter uses a 2-wire connection, **unless you are using the RS485 4-wire to 2-wire communication cable available from EIG's online store**, you will need to add jumper wires to convert the Unicom 2500 to the 2-wire configuration. As shown in Figure 5.6, you connect the "RX-" and "TX-" terminals with a jumper wire to make the "-" terminal, and connect the "RX+" and "TX+" terminals with a jumper wire to make the "+" terminal. See the figure on the right for the Unicom 2500's settings. The Unicom's Baud rate must match the Baud rate of the meter's RS485 port: you set the Baud rate by turning the screw to point at the rate you want.

## 5.2: Shark® 200T Transducer Communication and Programming Overview

The Shark® 200T transducer does not include a display on the front face of the meter; there are no buttons or IrDA Port on the face of the meter. Programming and communication utilize the RS485 connection on the back of the meter as shown in Figure 5.1. Once a connection is established, Communicator EXT$^{TM}$ 3.0 software can be used to program the meter and communicate to Shark® 200T transducer slave devices.

### Meter Connection

To provide power to the meter, attach an Aux cable to GND, L(+) and N(-). Refer to Section 4.8, Figure 1.

The RS485 cable attaches to SH, - and + as shown in Figure 5.1.

## 5.2.1: Accessing the Meter in Default Communication Mode

You can connect to the Shark® 200T in Default Communication mode. This feature is useful in debugging or if you do not know the meter's programmed settings and want to find them. For 5 seconds after the Shark® 200T is powered up, you can use the RS485 port with Default Communication mode to poll the Name Register. You do this by connecting to the meter with the following default settings (see Section 5.2.2 on the next page):

Baud Rate: 9600

Address: 1

Protocol: Modbus RTU

The meter continues to operate with these default settings for 5 minutes. During this time, you can access the meter's Device Profile to ascertain/change meter information. After 5 minutes of no activity, the meter reverts to the programmed Device Profile settings.

**IMPORTANT!** In Normal operating mode the initial factory communication settings are:

Baud Rate: 57600

Address: 1

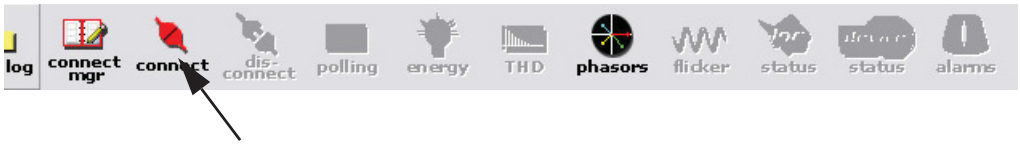
Protocol: Modbus RTU

### 5.2.2: Connecting to the Meter through Communicator EXT™ Software

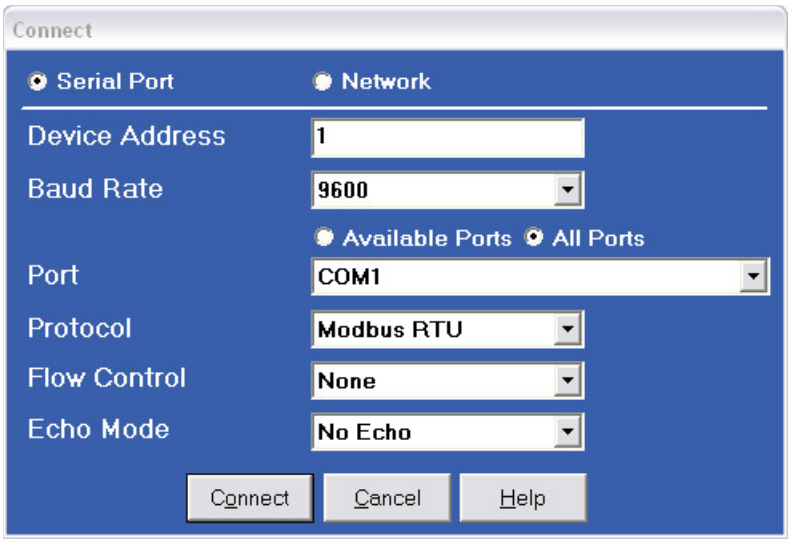
**How to Connect:**

1. Open the Communicator EXT™ software.

2. Click the **Connect** icon in the Icon bar.

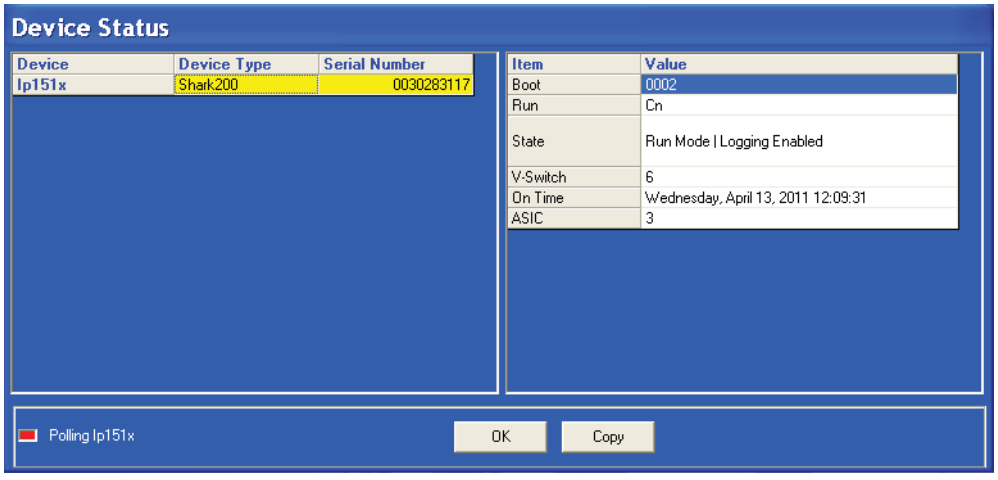


3. The Connect screen opens, showing the Default settings. Make sure your settings are the same as shown here. Use the pull-down menus to make any necessary changes to the settings.



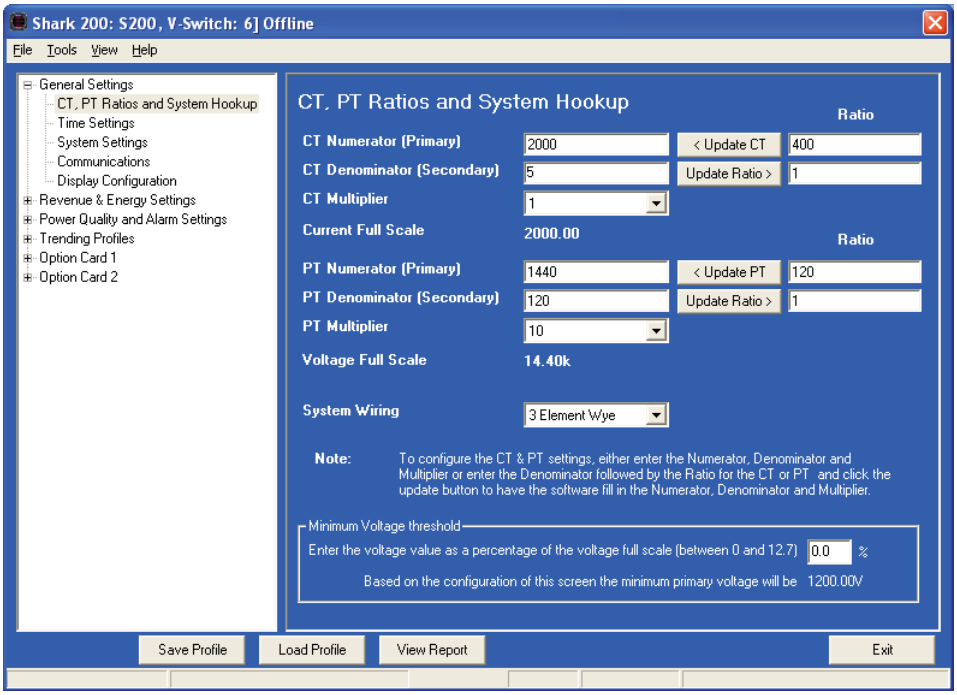

4. Click the **Connect** button. If you have a problem connecting, you may have to disconnect power to the meter, then reconnect power and click the Connect button, again.

5. You will see the Device Status screen, confirming connection to your meter. Click **OK**.

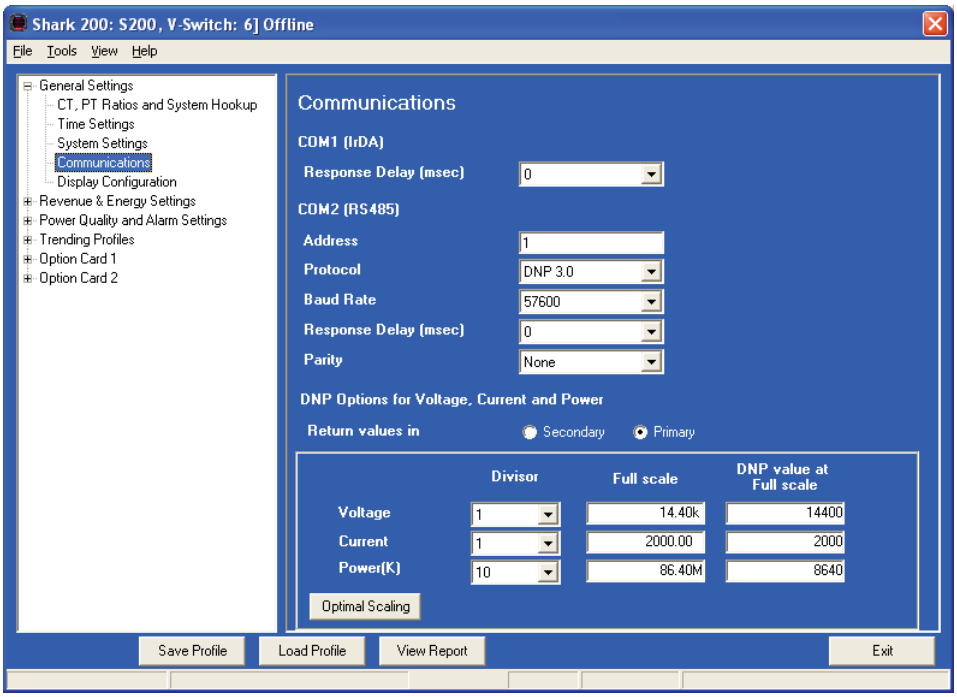



6. Click the **Profile** icon in the Title Bar.

7. You will see the Shark® 200 meter's Device Profile screen. The menu on the left side of the screen lets you navigate between Settings screens (see below).




Click **Communications**. You will see the screen shown below. Use this screen to enter communication settings for the meter's two on-board ports: the IrDA port (COM 1) and RS485 port (COM 2) Make any necessary changes to settings.



Valid Communication Settings are as follows:

| | |
|---|---|
| COM1 | (IrDA) |
| Response Delay | (0-750 msec) |
| COM2 | (RS485) |
| Address | (1-247) |
| Protocol | (Modbus RTU, Modbus ASCII or DNP) |
| Baud Rate | (1200 to 57600) Your meter must have Runtime Firmware Version 26 or higher to set Baud rates of 1200, 2400, and 4800. |
| Response Delay | (0-750 msec) |
| Parity | (Odd, Even, or None) Your meter must have Runtime Firmware version 26 or higher to be able to set Parity. |

DNP Options for Voltage, Current, and Power - these fields allow you to choose Primary or Secondary Units for DNP, and to set custom scaling if you choose Primary. Click the Optimal Scaling button to have the software choose a divisor for voltage, current, and power, that will not result in an over/under-range.

**NOTE:** You must set the DNP polling software to multiply by the divisor amount before showing the final value.

See Chapter 5 in the *Communicator EXT*™ *User Manual* for more information.

8. When changes are complete, click the **Update Device** button to send a new profile to the meter.

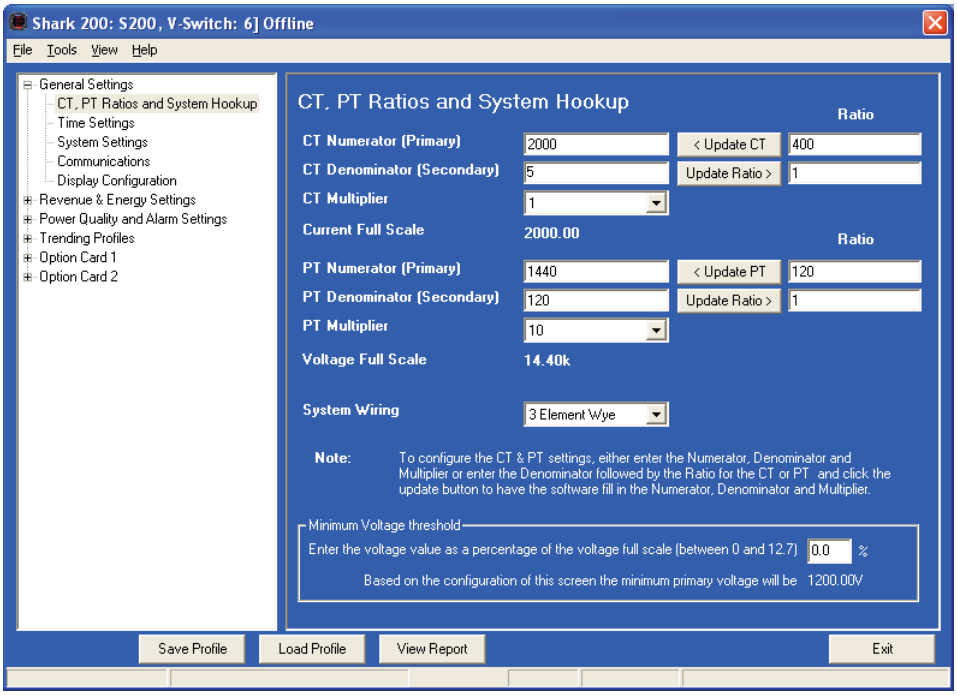
9. Click **Exit** to leave the Device Profile or click other menu items to change other aspects of the Device Profile (see the following section for instructions).

### 5.2.2.1: Shark® 200 Meter Device Profile Settings

**IMPORTANT!** Modification to the Device Profile may cause improper Option card operation due to changed Scaling, etc. Verify or update programmable settings related to any Option cards installed in the Shark® 200 meter.

**NOTE:** Only the basic Shark® 200 meter Device Profile settings are explained in this manual. Refer to Chapter 5 in the *Communicator EXT™ User Manual* for detailed instructions on configuring all settings of the meter's Device Profile. You can view the manual online by clicking **Help>Contents** from the Communicator EXT™ Main screen.

#### CT, PT Ratios and System Hookup




**IMPORTANT!** You have two options for entering the CT and PT settings. You can either enter CT/PT Numerator, Denominator, and Multiplier manually (see instructions below), or you can enter the Ratios for CT/PT Numerator and Denominator and click the Update CT/Update PT buttons to let the software calculate the Numerator, Denominator, and Multiplier for you. You can then empty the Ratio fields and click the Update Ratio buttons to confirm the calculated settings: you will see the same ratios you initially entered.

**For manual entry:**

CT Ratios

CT Numerator (Primary): 1 - 9999

CT Denominator (Secondary): 5 or 1 Amp

**NOTE**: This field is display only.

Either CT Multiplier (Scaling): 1, 10 or 100

OR Ratio: the ratio to be applied, and click Update CT

Current Full Scale: Display only.

PT Ratios

PT Numerator (Primary): 1 - 9999

PT Denominator (Secondary): 40 - 600

PT Multiplier (Scaling): 1, 10, 100, or 1000

Voltage Full Scale: Display only.

System Wiring

3 Element Wye; 2.5 Element Wye; 2 CT Delta

Example Settings:

For a CT of 2000/5A, set the following CT Ratios in the entry fields:

| | |
|---|---|
| CT Numerator (Primary) | 2000 |
| CT Denominator (Secondary) | 5 |
| CT Multiplier | 1 |

The Current Full Scale field will read 2000.

**NOTE**: You can obtain the same Current Full Scale by entering a CT Numerator of 200 and a CT Multiplier of 10.

For a system that has 14400V primary with a 120V secondary line to neutral (PT Ratio of 120:1), set the following PT Ratios in the entry fields:

PT Numerator (Primary) 1440

PT Denominator (Secondary) 120

PT Multiplier 10

The Voltage Full Scale field will read 14.4k.

Use the box at the bottom of the screen to enter the minimum voltage threshold, which is a percentage of the voltage full scale. Enter a percentage between 0 and 12.7 in the % entry field. The minimum primary voltage based on the percentage you entered is displayed at the bottom of the screen.

**Example CT Settings:**

200/5 Amps: Set the Ct-n value for 200, Ct-Multiplier value for 1

800/5 Amps: Set the Ct-n value for 800, Ct-Multiplier value for 1

2,000/5 Amps: Set the Ct-n value for 2000, Ct-Multiplier value for 1

10,000/5 Amps: Set the Ct-n value for 1000, Ct-Multiplier value for 10

**Example PT Settings:**

277/277 Volts: Pt-n value is 277, Pt-d value is 277, Pt-Multiplier is 1

14,400/120 Volts: Pt-n value is 1440, Pt-d value is 120, Pt-Multiplier value is 10

138,000/69 Volts: Pt-n value is 1380, Pt-d value is 69, Pt-Multiplier value is 100

345,000/115 Volts: Pt-n value is 3450, Pt-d value is 115, Pt-Multiplier value is 100

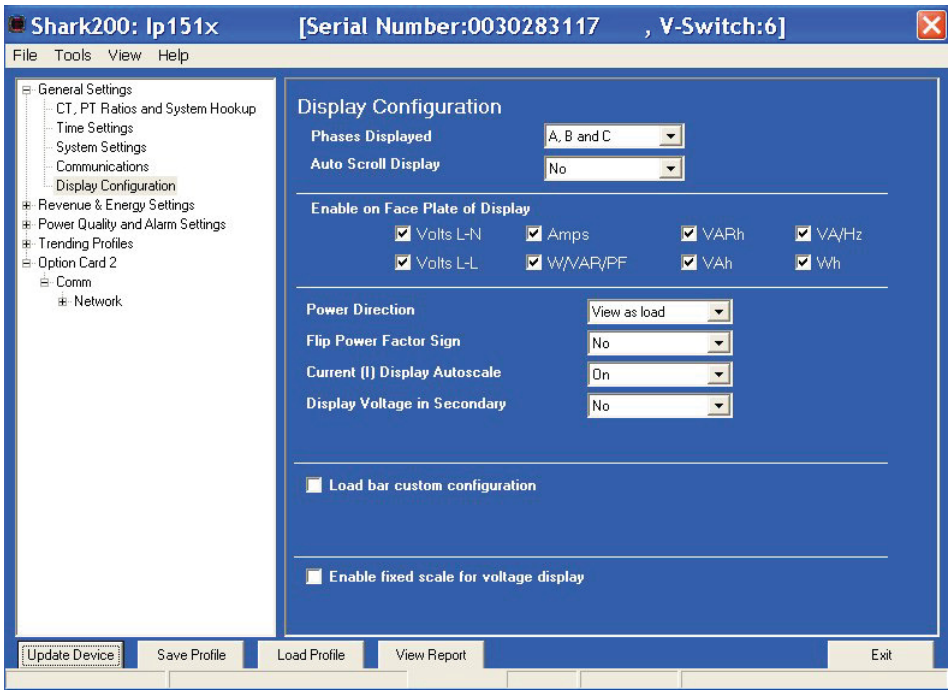
345,000/69 Volts: Pt-n value is 345, Pt-d value is 69, Pt-Multiplier value is 1000

**NOTE:** Settings are the same for Wye and Delta configurations.

### Display Configuration

The settings on this screen determine the display configuration of the meter's faceplate.

**NOTE:** For a Shark® 200T transducer, the Display Configuration setting does not apply as there is no display.




The screen fields and acceptable entries are as follows:

**Phases Displayed**: A; A and B; A, B, and C. This field determines which phases are displayed on the faceplate. For example, if you select A and B, only those two phases will be displayed on the faceplate.

**Auto Scroll Display**: Yes or No. This field enables/disables the scrolling of selected readings on the faceplate. If enabled, the readings scroll every 5 seconds.

**Enable on Face Plate of Display**: Check the boxes of the Readings you want displayed on the faceplate of the meter. You must select at least one reading.

**Power Direction**: View as Load or View as Generator

**Flip Power Factor Sign**: Yes or No

**Current (I) Display Autoscale**: On to apply scaling to the current display or Off (No decimal places)

**Display Voltage in Secondary:** Yes or No

**Load Bar Custom Configuration:** To enter scaling for the Load Bar, click the Load Bar Custom Configuration checkbox. Fields display on the screen that allow you to enter a Scaling factor for the display. See the figure below.

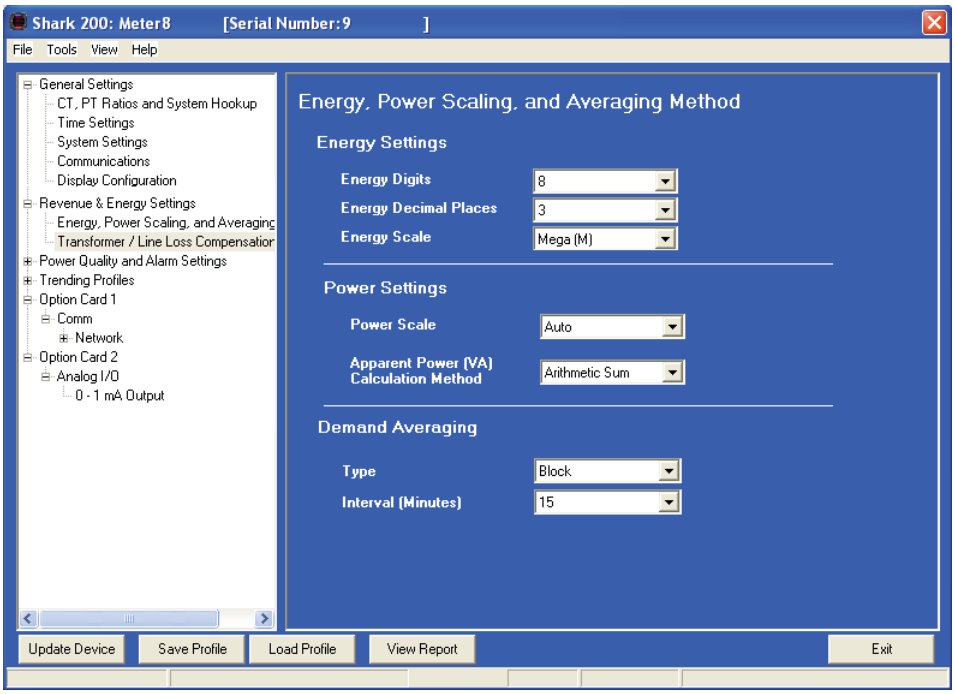
Load bar custom configuration
Note: The Primary full scale Current for load bar = Current Scale * CT Multiplier
Current Scale
0
Primary Full Scale
0.00

Enter the scaling factor you want in the Current Scale field. This field is multiplied by the CT Multiplier (set in the CT, PT Ratios, and System Hookup screen) to arrive at the Primary Full Scale. Make sure you set the CT multiplier correctly.

**Enable Fixed Scale for Voltage Display**: To enter a scaling factor for the Voltage display, click the checkbox next to Enable Fixed Scale for Voltage Display. The screen changes - see the figure below.

Select the scaling you want to use from the pull-down menu. The options are: 0, 100.0kV, 10.00kV, or 0kV.

### Energy, Power Scaling, and Averaging




The screen fields and acceptable entries are as follows:

#### Energy Settings

Energy Digits: 5; 6; 7; 8

Energy Decimal Places: 0 - 6

Energy Scale: unit; kilo (K); Mega (M)

Example: a reading for Digits: 8; Decimals: 3; Scale: K would be formatted as 00123.456k

#### Power Settings

Power Scale: Auto; unit; kilo (K); Mega (M)

Apparent Power (VA) Calculation Method: Arithmetic Sum; Vector Sum

#### Demand Averaging

Type: Block or Rolling

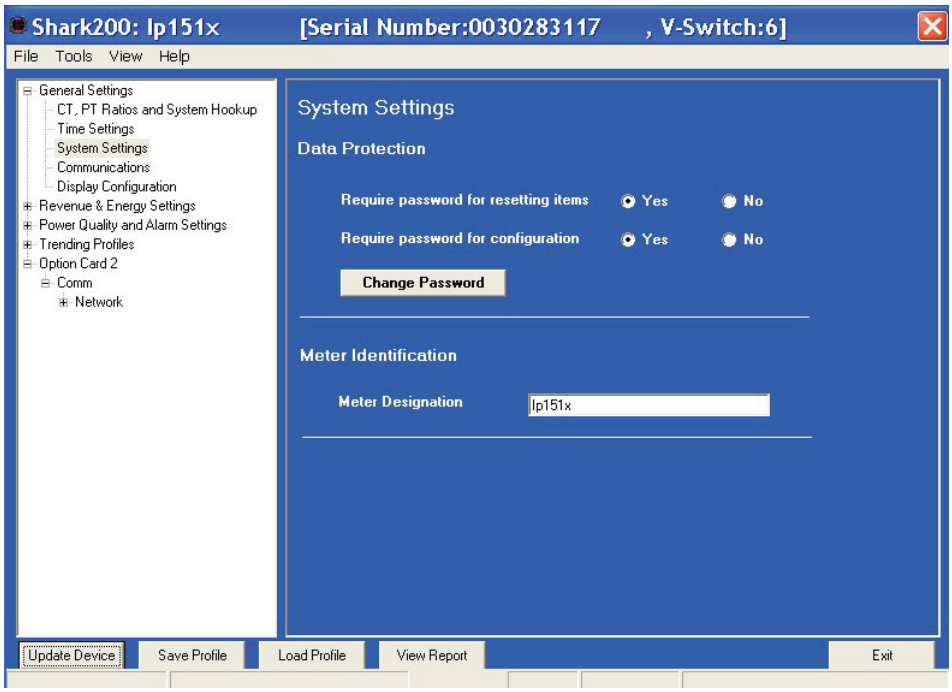
Interval (Block demand) or Sub-Interval (Rolling demand) in minutes: 5; 15; 30; 60

Number of Subintervals: 1; 2; 3; 4

Interval Window: This field is display only. It is the product of the values entered in the Sub-Interval and Number of Subintervals fields.

**NOTE:** You will only see the Number of Subintervals and Interval Window fields if you select Rolling Demand.

### System Settings




From this screen, you can do the following:

- Enable or disable password for Reset (reset max/min Energy settings, Energy accumulators, and the individual logs) and/or Configuration (Device profile): click the radio button next to Yes or No.

  **NOTES:**

  - If you enable a password for reset, you must also enable it for configuration.
  - The meter's default is password disabled.
  - Enabling Password protection prevents unauthorized tampering with devices. When a user attempts to make a change that is under Password protection, Communicator EXT™ software opens a screen asking for the password. If the correct password is not entered, the change does not take place.

**IMPORTANT!** You must set up a password before enabling Password protection. Click the **Change** button next to Change Password if you have not already set up a password.

- Change the Password: click the **Change** button. You will see the Enter the New Password screen, shown below.

1. Type in the new password (0 - 9999).

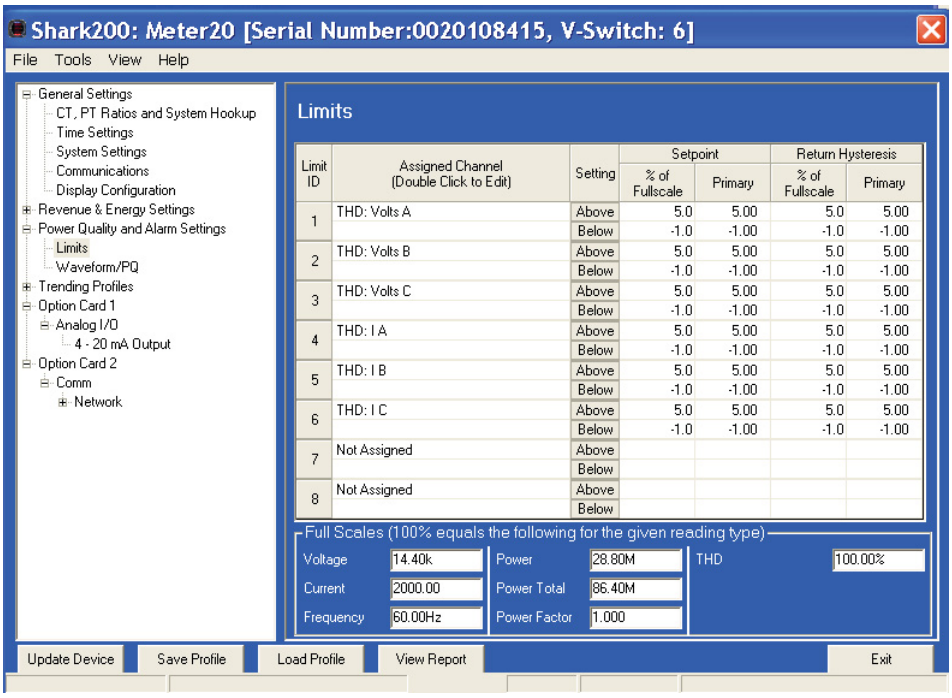
2. Retype the password.

3. Click **Change**. The new password is saved and the meter restarts.
   **NOTE:** If Password protection has already been enabled for configuration and you attempt to change the password, you will see the Enter Password screen after you click **Change**. Enter the old password and click **OK** to proceed with the password change.

- Change the Meter Identification: input a new meter label into the Meter Designation field.

### Limits

Limits are transition points used to divide acceptable and unacceptable measurements. When a value goes above or below the limit an out-of-limit condition occurs. Once they are configured, you can view the out-of-Limits (or Alarm) conditions in the Limits log or Limits polling screen. You can also use Limits to trigger relays. See the *Communicator EXT*™ *User Manual* for details.

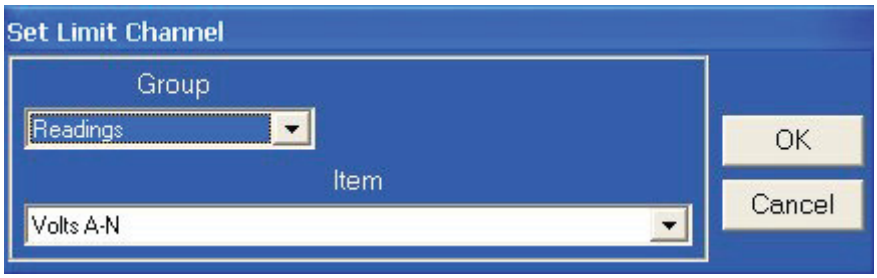



The current settings for Limits are shown in the screen. You can set and configure up to eight Limits for the Shark® 200 meter.

**To set up a Limit:**

1. Select a Limit by double-clicking on the Assigned Channel field.

2. You will see the screen shown below. Select a Group and an Item for the Limit.



3. Click **OK**.

**To configure a Limit:**

Double-click on the field to set the following values:

**Above and Below Setpoint**: % of Full Scale (the point at which the reading goes out of limit)

**Examples**:

100% of 120V Full Scale = 120V

90% of 120V Full Scale = 108V

**Above and Below Return Hysteresis**: the point at which the reading goes back within limit (see figure below)

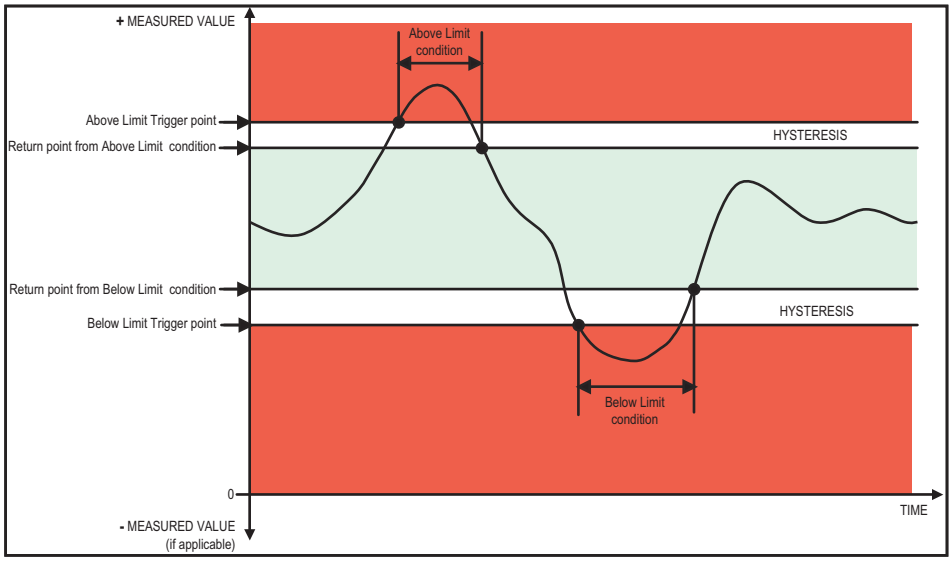
**Examples**:

Above Setpoint = 110%; Below Setpoint = 90%

(Out of Limit above 132V);(Out of Limit below 108V)

Above Return Hysteresis = 105%; Below Return Hysteresis = 95%

(Stay out of Limit until below 126V)(Stay out of Limit until above 114V)




**Primary Fields:** These fields are display only. They show what the setpoint and return hysteresis value are for each limit.

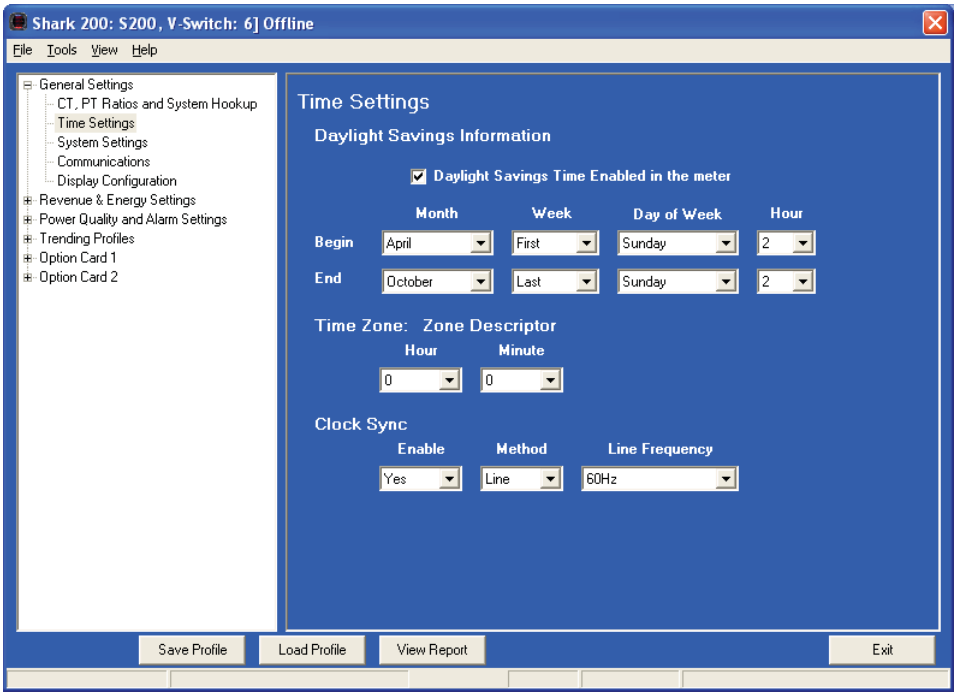
**NOTES:**

- If you are entering negative Limits, be aware that the negative value affects the way the above and below Limits function, since negative numbers are processed as signed values.
- If the Above Return Hysteresis is greater than the Above Setpoint, the Above Limit is Disabled; if the Below Return Hysteresis is less than the Below Setpoint, the Below Limit is Disabled. You may want to use this feature to disable either Above or Below Limit conditions for a reading.

### Time Settings

Use this setting to enable or disable Daylight Savings Time for the meter, to set the beginning and ending times for Daylight Savings Time, and to set up Time Zone information and clock synchronization information.

From the Tree Menu, click **General Settings>Time Settings**.




Check the box to Enable Daylight Savings time, or un-check it to Disable Daylight Savings Time.

Use the entry fields to set the start and end times for the Daylight Savings Time feature, if enabled. Select the values you want from the Month, Week, Day of the Week, and Hour fields.

**NOTE**: The Hour field uses a 24-Hour clock.

The other fields on the screen are used to set up clock synchronization for the meter. There are two available clock synchronization methods:

1. If your meter has the Network Option card, you can use the card to access a Network Time Protocol (NTP) Server for clock synchronization.

2. You can use line frequency synchronization (Line Sync) for clock synchronization. Line Sync synchronizes the clock to the AC frequency. This a very common synchronizing method.

**Use these fields to set up NTP clock synchronization:**

1. **Time Zone**: **Zone Descriptor** - Select the hour and minute of your time zone in relation to Greenwich Mean Time. For example, if your time zone is Eastern Standard time, you would select -5 from the pull-down Hour menu and leave the Minutes field at 0.

2. Under **Clock Sync** select:

   - **Yes** from the **Enable** pull-down menu
   - **NTP** from the **Method** pull-down menu
   - The location of the Network Option card - select either **Option Card in Slot 1** or **Option Card in Slot 2** from the **Interface** pull-down menu.

**NOTE:** You also need to set up the NTP server information when you configure the Network card's settings. See Chapter 5 of the *Communicator EXT*™ *User Manual* for instructions.

**Use these fields to set up Line Frequency clock synchronization:**

Under **Clock Sync** select:

- **Yes** from the Enable pull-down menu

- **Line** (line frequency synchronization) from the **Method** pull-down menu
- **50Hz** or **60Hz** from the **Line Frequency** pull-down menu

**IMPORTANT!** When you finish making changes to the Device Profile, click **Update Device** to send the new Profile settings to the meter.

**NOTE:** Refer to Chapter 5 of the *Communicator EXT*™ *User Manual* for additional instructions on configuring the Shark® 200 meter settings, including Transformer and Line Loss Compensation, CT and PT Compensation, Option card configuration, Secondary Voltage display, Symmetrical Components, Voltage and Current Unbalance, and scaling Primary readings for use with DNP.

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# 6: Using the Shark® 200 Meter

## 6.1: Introduction

You can use the Elements and Buttons on the Shark® 200 meter's face to view meter readings, reset and/or configure the meter, and perform related functions. The following sections explain the Elements and Buttons and detail their use.

### 6.1.1: Understanding Meter Face Elements

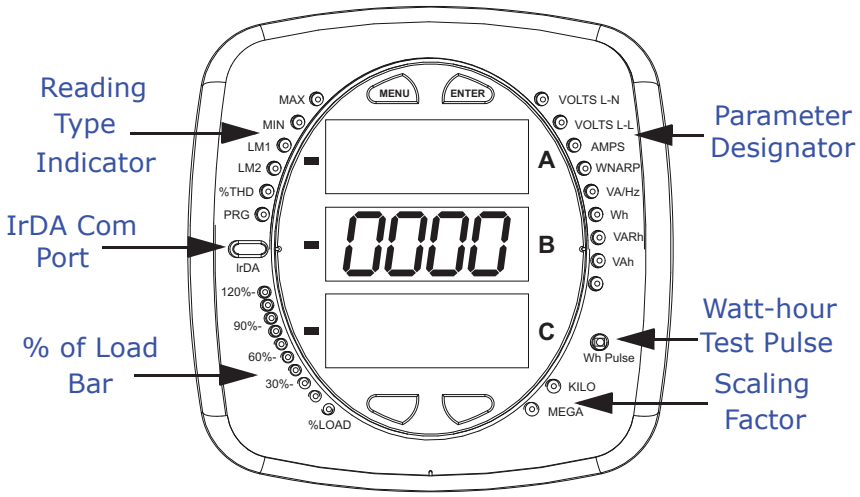



Figure 6.1: Face Plate with Elements

The meter face features the following elements:

- Reading type indicator: e.g., Max
- Parameter designator: e.g., Volts L-N
- Watt-hour test pulse: Energy pulse output to test accuracy
- Scaling factor: Kilo or Mega multiplier of displayed readings
- % of Load bar: Graphic Display of Amps as % of the load (see Section 6.3 for additional information)
- IrDA Communication port: Com 1 port for wireless communication

### 6.1.2: Understanding Meter Face Buttons

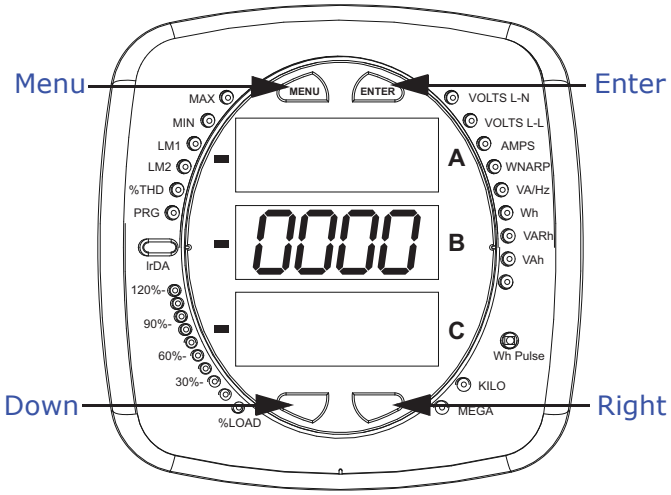



Figure 6.2: Faceplate with Buttons

The meter face has **Menu**, **Enter**, **Down** and **Right** buttons, which let you perform the following functions:

- View meter information
- Enter display modes
- Configure parameters (may be Password protected)
- Perform resets (may be Password protected)
- Perform LED Checks
- Change settings
- View parameter values
- Scroll parameter values
- View Limit states

## 6.2: Using the Front Panel

You can access four modes using the Shark® 200 meter's front panel buttons:

- Operating mode (Default)
- Reset mode
- Configuration mode
- Information mode - Information mode displays a sequence of screens that show model information, such as Frequency, Amps, V-Switch, etc.

Use the **Menu**, **Enter**, **Down** and **Right** buttons to navigate through each mode and its related screens.

**NOTES:**

- See Appendix A for the display's Navigation maps.
- The meter can also be configured using software; see Chapter 5 and the *Communicator EXT User Manual* for instructions.

### 6.2.1: Understanding Startup and Default Displays

Upon powering up, the meter displays a sequence of screens:

- Lamp Test screen where all LEDs are lit
- Lamp Test screen where all digits are lit
- Firmware screen showing the build number
- Error screen (if an error exists)

After startup, if auto-scrolling is enabled, the Shark® 200 meter scrolls the parameter readings on the right side of the front panel. The Kilo or Mega LED lights, showing the scale for the Wh, VARh and VAh readings. Figure 6.3 shows an example of a Wh reading.

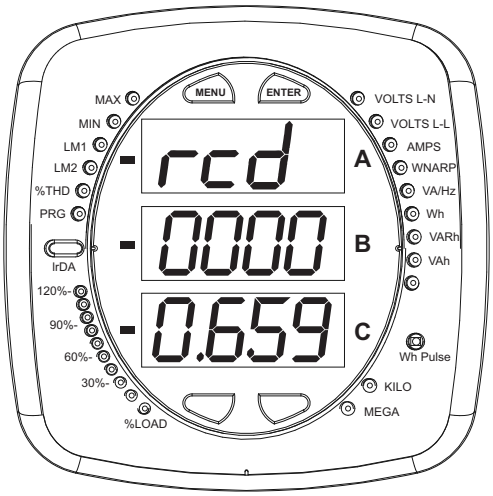



Figure 6.3: Display Showing Watt-hour Reading

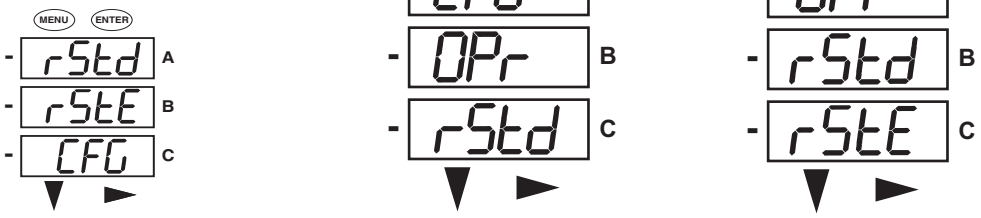
The Shark® 200 meter continues to provide scrolling readings until one of the buttons on the front panel is pressed, causing the meter to enter one of the other Modes.

## 6.2.2: Using the Main Menu

1. Press the **Menu** button. The Main Menu screen appears.

- The Reset: Demand mode (rStd) appears in the A window. Use the Down button to scroll, causing the Reset: Energy (rStE), Configuration (CFG), Operating (OPr), and Information (InFo) modes to move to the A window.

- The mode that is currently flashing in the A window is the "Active" mode, which means it is the mode that can be configured.




For example: Press Down Twice - CFG moves to A window. Press Down Twice - OPr moves to A window.

2. Press the **Enter** button from the Main Menu to view the Parameters screen for the mode that is currently active.

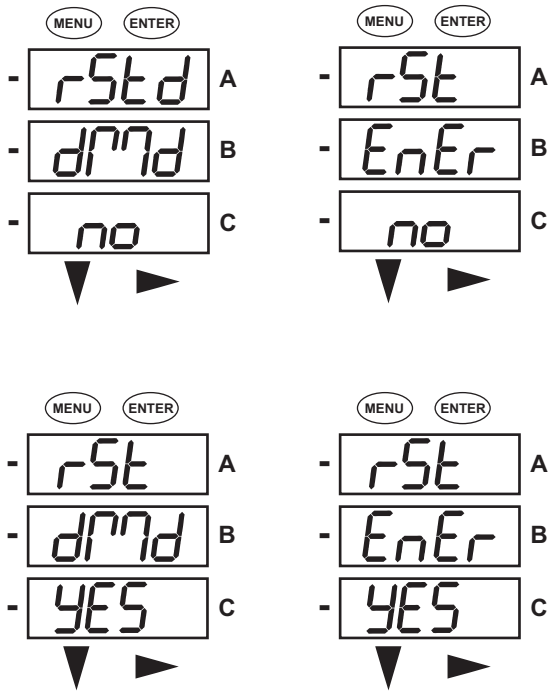
### 6.2.3: Using Reset Mode

Reset Mode has two options:

- Reset: Demand (rStd): resets the Max and Min values
- Reset: Energy (rStE): resets the energy accumulator fields

1. Press the Enter button while either rStd or rStE is in the A window. The Reset Demand No or Reset Energy No screen appears.

   - If you press the **Enter** button again, the Main Menu appears, with the next mode in the A window. (The **Down** button does not affect this screen.)
   - If you press the **Right** button, the Reset Demand YES or Reset Energy YES screen appears. Press **Enter** to perform a reset.




**NOTE:** If Password protection is enabled for reset, you must enter the four digit password before you can reset the meter. (See Chapter 5 for information on Password protection.) To enter a password, follow the instructions in Section 6.2.4.

**CAUTION!** Reset Demand YES resets **all** Max and Min values.

2. Once you have performed a reset, the screen displays either "rSt dMd donE" or "rSt EnEr donE"and then resumes auto-scrolling parameters.

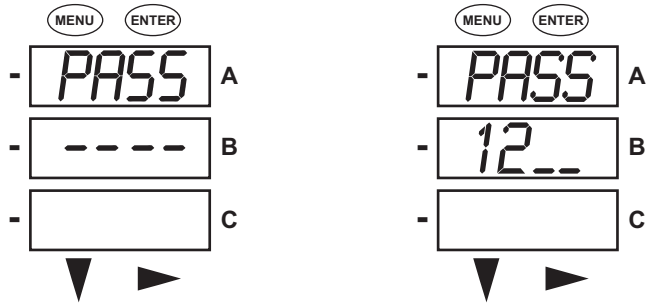
### 6.2.4: Entering a Password

If Password Protection has been enabled in the software for reset and/or configuration (see Chapter 5 for more information), a screen appears requesting a password when you try to reset the meter and/or configure settings through the front panel.

- PASS appears in the A window and 4 dashes appear in the B window; the left-most dash is flashing.

1. Press the **Down** button to scroll numbers from 0 to 9 for the flashing dash. When the correct number appears for that dash, use the **Right** button to move to the next dash.

**Example**: The left screen, below, shows four dashes. The right screen shows the display after the first two digits of the password have been entered.




2. When all 4 digits of the password have been selected, press the **Enter** button.

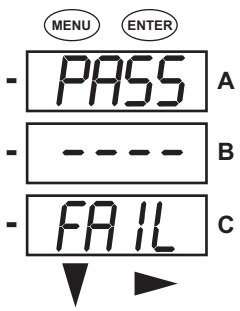
- If you are in Reset mode and you enter the correct password, "rSt dMd donE" or "rSt EnEr donE"appears and the screen resumes auto-scrolling parameters.

- If you are in Configuration mode and you enter the correct password, the display returns to the screen that required a password.

- If you enter an incorrect Password, "PASS ---- FAIL" appears and:

  - The previous screen is redisplayed, if you are in Reset mode.

  - The previous Operating mode screen is redisplayed, if you are in Configuration mode.



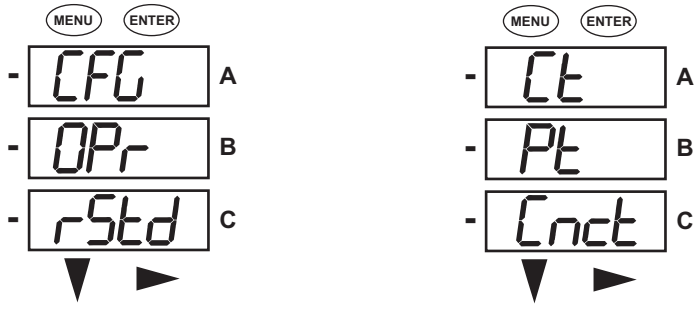
### 6.2.5: Using Configuration Mode

Configuration mode follows Reset: Energy on the Main Menu.

**To access Configuration mode:**

1. Press the **Menu** button while the meter is auto-scrolling parameters.
2. Press the **Down** button until the Configuration mode option (CFG) is in the A window.
3. Press the **Enter** button. The configuration Parameters screen appears.
4. Press the **Down** button to scroll through the configuration parameters: Scroll (SCrL), CT, PT, Connection (Cnct) and Port. The parameter currently 'Active," i.e., configurable, flashes in the A window.
5. Press the **Enter** button to access the Setting screen for the currently active parameter.

**NOTE:** You can use the **Enter** button to scroll through all of the configuration parameters and their Setting screens, in order.




Press **Enter** when CFG is in A window - Parameter screen appears -

Press **Down**- Press **Enter** when

Parameter you want is in A window

6. The parameter screen appears, showing the current settings. To change the settings:
   - Use either the **Down** button or the **Right** button to select an option.

- To enter a number value, use the **Down** button to select the number value for a digit and the **Right** button to move to the next digit.

**NOTE:** When you try to change the current setting and Password protection is enabled for the meter, the Password screen appears. See Section 6.2.4 for instructions on entering a password.

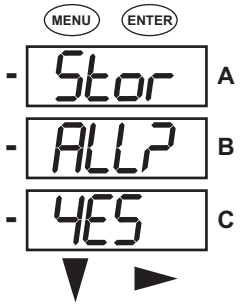
7. Once you have entered the new setting, press the **Menu** button twice.

8. The Store ALL YES screen appears. You can either:

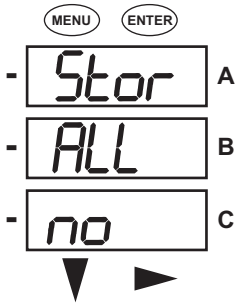
- Press the **Enter** button to save the new setting.

- Press the **Right** button to access the Store ALL no screen; then press the **Enter** button to cancel the Save.

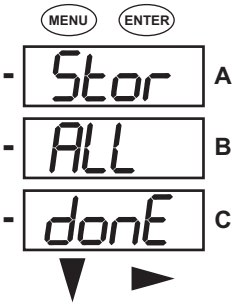
9. If you have saved the settings, the Store ALL done screen appears and the meter resets.




Press the **Enter** button to save the settings. Press the **Right** button for Stor All no screen.




Press the **Enter** button to Cancel the Save.



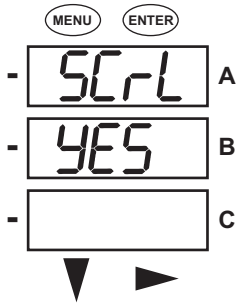

The settings have been saved.

### 6.2.5.1: Configuring the Scroll Feature

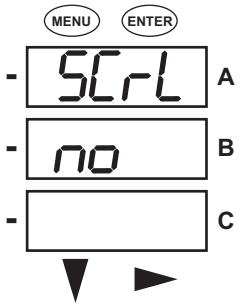
When in auto-scrolling mode, the meter performs a scrolling display, showing each parameter for 7 seconds, with a 1 second pause between parameters. The parameters that the meter displays are determined by the following conditions:

- They have been selected through software (see the *Communicator EXT User Manual* for instructions).
- They are enabled by the installed V-Switch™ key (see Section 2.1.3 for information on V-Switch™ keys).

**To enable or disable auto-scrolling:**




1. Press the **Enter** button when SCrl is in the A window. The Scroll YES screen appears.
2. Press either the **Right** or **Down** button if you want to access the Scroll no screen. To return to the Scroll YES screen, press either button.




3. Press the **Enter** button on either the Scroll YES screen (to enable auto-scrolling) or the Scroll no screen (to disable auto-scrolling).
4. The CT- n screen appears (this is the next Configuration mode parameter).

**NOTES:**

- To exit the screen without changing scrolling options, press the **Menu** button.
- To return to the Main Menu screen, press the **Menu** button twice.
- To return to the scrolling (or non-scrolling) parameters display, press the **Menu** button three times.

### 6.2.5.2: Configuring CT Setting

The CT Setting has three parts: Ct-n (numerator), Ct-d (denominator), and Ct-S (scaling).

1. Press the **Enter** button when Ct is in the A window. The Ct-n screen appears. You can either:

   - Change the value for the CT numerator.
   - Access one of the other CT screens by pressing the **Enter** button: press **Enter** once to access the Ct-d screen, twice to access the Ct-S screen.

     **NOTE:** The Ct-d screen is preset to a 5 Amp or 1 Amp value at the factory and cannot be changed.

   a. To change the value for the CT numerator:
   From the Ct-n screen:
   - Use the **Down** button to select the number value for a digit.
   - Use the **Right** button to move to the next digit.

   b. To change the value for CT scaling:
   From the Ct-S screen, use the **Right** button or the **Down** button to choose the scaling you want. The Ct-S setting can be 1, 10, or 100.

**NOTE:** If you are prompted to enter a password, refer to Section 6.2.4 for instructions on doing so.

2. When the new setting is entered, press the **Menu** button twice.

3. The Store ALL YES screen appears. Press **Enter** to save the new CT setting.

**Example CT Settings**:

200/5 Amps: Set the Ct-n value for 200 and the Ct-S value for 1.

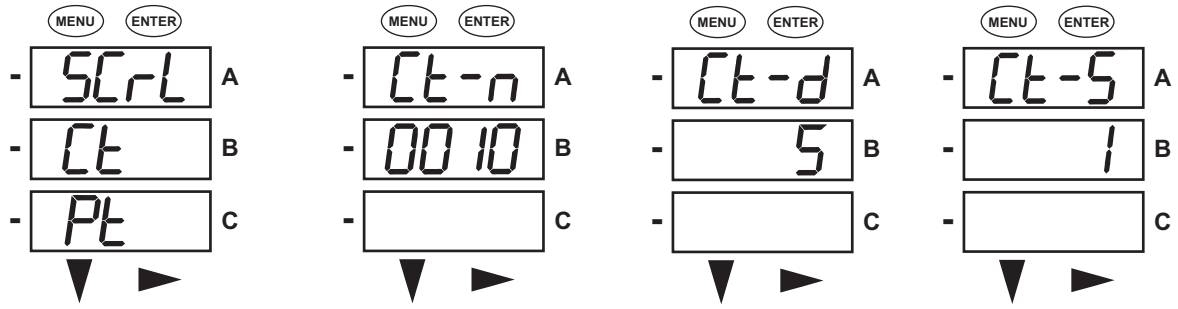
800/5 Amps: Set the Ct-n value for 800 and the Ct-S value for 1.

2,000/5 Amps: Set the Ct-n value for 2000 and the Ct-S value for 1.

10,000/5 Amps: Set the Ct-n value for 1000 and the Ct-S value for 10.

**NOTES:**

- The value for Amps is a product of the Ct-n value and the Ct-S value.
- Ct-n and Ct-S are dictated by primary current; Ct-d is secondary current.




Press **Enter** | Use buttons to set Ct-n | Ct-d cannot be changed | Use buttons to select scaling

### 6.2.5.3: Configuring PT Setting

The PT Setting has three parts: Pt-n (numerator), Pt-d (denominator), and Pt-S (scaling).

1. Press the **Enter** button when Pt is in the A window. The PT-n screen appears. You can either:

   - Change the value for the PT numerator.
   - Access one of the other PT screens by pressing the **Enter** button: press **Enter** once to access the Pt-d screen, twice to access the Pt-S screen.

   a. To change the value for the PT numerator or denominator:
   From the Pt-n or Pt-d screen:
   - Use the **Down** button to select the number value for a digit.
   - Use the **Right** button to move to the next digit.

   b. To change the value for the PT scaling:
   From the Pt-S screen, use the **Right** button or the **Down** button to choose the scaling you want. The Pt-S setting can be 1, 10, 100, or 1000.

**NOTE:** If you are prompted to enter a password, refer to Section 6.2.4 for instructions on doing so.

2. When the new setting is entered, press the **Menu** button twice.

3. The STOR ALL YES screen appears. Press **Enter** to save the new PT setting.

**Example PT Settings**:

277/277 Volts: Pt-n value is 277, Pt-d value is 277, Pt-S value is 1.

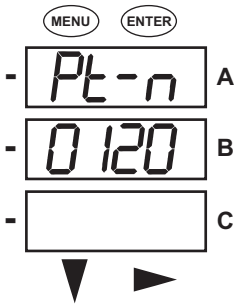
14,400/120 Volts: Pt-n value is 1440, Pt-d value is 120, Pt-S value is 10.

138,000/69 Volts: Pt-n value is 1380, Pt-d value is 69, Pt-S value is 100.

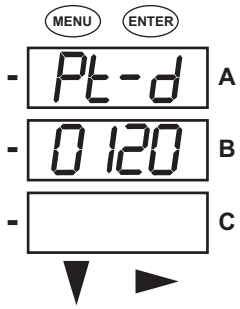
345,000/115 Volts: Pt-n value is 3450, Pt-d value is 115, Pt-S value is 100.

345,000/69 Volts: Pt-n value is 345, Pt-d value is 69, Pt-S value is 1000.

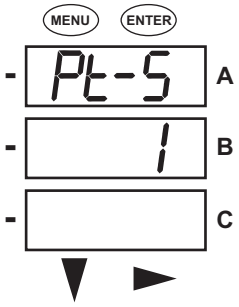
**NOTE:** Pt-n and Pt-S are dictated by primary voltage; Pt-d is secondary voltage.




Use buttons to set Pt-n




Use buttons to set Pt-d




Use buttons to select scaling

### 6.2.5.4: Configuring Connection Setting

1. Press the **Enter** button when Cnct is in the A window. The Cnct screen appears.

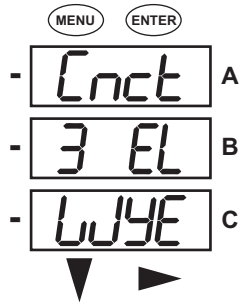
2. Press the **Right** button or **Down** button to select a configuration. The choices are:

   - 3 Element Wye (3 EL WYE)
   - 2.5 Element Wye (2.5EL WYE)
   - 2 CT Delta (2 Ct dEL)

**NOTE:** If you are prompted to enter a password, refer to Section 6.2.4 for instructions on doing so.

3. When you have made your selection, press the **Menu** button twice.

4. The STOR ALL YES screen appears. Press **Enter** to save the setting.




Use buttons to select configuration

### 6.2.5.5: Configuring Communication Port Setting

Port configuration consists of: Address (a three digit number), Baud Rate (9600; 19200; 38400; or 57600), and Protocol (DNP 3.0; Modbus RTU; or Modbus ASCII).

1. Press the **Enter** button when POrt is in the A window. The Adr (address) screen appears. You can either:

   - Enter the address.
   - Access one of the other Port screens by pressing the **Enter** button: press **Enter** once to access the bAUd screen (Baud Rate), twice to access the Prot screen (Protocol).

a. To enter the Address:

From the Adr screen:

- Use the **Down** button to select the number value for a digit.
- Use the **Right** button to move to the next digit.

b. To select the Baud Rate:

From the bAUd screen, use the **Right** button or the **Down** button to select the setting you want.

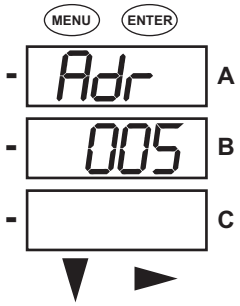
c. To select the Protocol:

From the Prot screen, press the **Right** button or the **Down** button to select the setting you want.

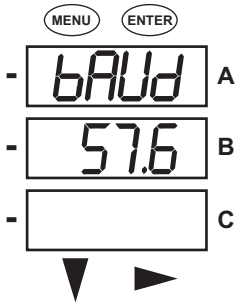
**NOTE:** If you are prompted to enter a password, refer to Section 6.2.4 for instructions on doing so.

2. When you have finished making your selections, press the **Menu** button twice.

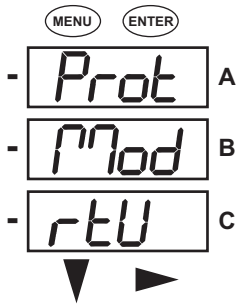
3. The STOR ALL YES screen appears. Press **Enter** to save the settings.




Use buttons to enter Address




Use buttons to select Baud Rate




Use buttons to select Protocol

### 6.2.6: Using Operating Mode

Operating mode is the Shark® 200 meter's default mode, that is, the standard front panel display. After starting up, the meter automatically scrolls through the parameter screens, if scrolling is enabled. Each parameter is shown for 7 seconds, with a 1 second pause between parameters. Scrolling is suspended for 3 minutes after any button is pressed.

1. Press the **Down** button to scroll all the parameters in Operating mode. The currently "Active," i.e., displayed, parameter has the Indicator light next to it, on the right face of the meter.

2. Press the **Right** button to view additional readings for that parameter. The table below shows possible readings for Operating Mode. Sheet 2 in Appendix A shows the Operating mode Navigation map.

**NOTE:** Readings or groups of readings are skipped if not applicable to the meter type or hookup, or if they are disabled in the programmable settings.

**OPERATING MODE PARAMETER READINGS**

**POSSIBLE READINGS**

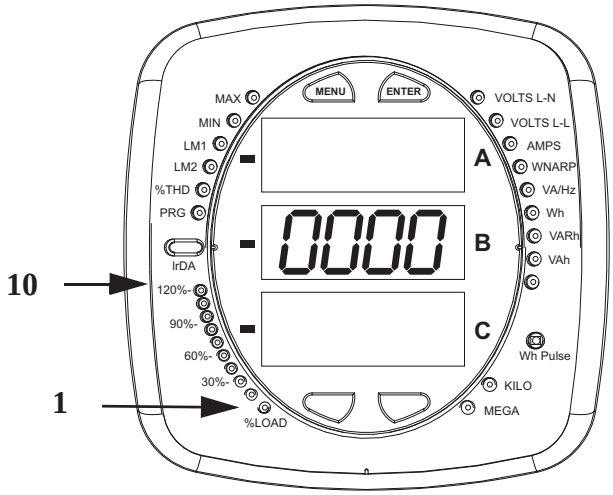
| | | | | | |
|---|---|---|---|---|---|
| VOLTS L-N | VOLTS_LN | VOLTS_LN_MAX | VOLTS_LN_MIN | | VOLTS_LN_THD |
| VOLTS L-L | VOLTS_LL | VOLTS_LL_MAX | VOLTS_LL_MIN | | |
| AMPS | AMPS | AMPS_NEUTRAL | AMPS_MAX | AMPS_MIN | AMPS_THD |
| W/VAR/PF | W_VAR_PF | W_VAR_PF_MAX_POS | W_VAR_PF_MIN_POS | W_VAR_PF_MIN_NEG | |
| VA/Hz | VA_FREQ | VA_FREQ_MAX | VA_FREQ_MIN | | |
| Wh | KWH_REC | KWH_DEL | KWH_NET | KWH_TOT | |
| VARh | KVARH_POS | KVARH_NEG | KVARH_NET | KVARH_TOT | |
| VAh | KVAH | | | | |

## 6.3: Understanding the % of Load Bar

The 10-segment LED bar graph at the bottom left of the Shark® 200 meter's front panel provides a graphic representation of Amps. The segments light according to the load, as shown in the table below.

When the load is over 120% of Full Load, all segments flash "On" (1.5 secs) and "Off" (0.5 secs).

| Segments | Load >= % Full Load |
|---|---|
| none | no load |
| 1 | 1% |
| 1-2 | 15% |
| 1-3 | 30% |
| 1-4 | 45% |
| 1-5 | 60% |
| 1-6 | 72% |
| 1-7 | 84% |
| 1-8 | 96% |
| 1-9 | 108% |
| 1-10 | 120% |
| All Blink | >120% |




The % of Load bar can be programmed through Communicator EXT - see Section 5.2.2, page 5-14 for instructions.

## 6.4: Performing Watt-Hour Accuracy Testing (Verification)

To be certified for revenue metering, power providers and utility companies must verify that the billing energy meter performs to the stated accuracy. To confirm the meter's performance and calibration, power providers use field test standards to ensure that the unit's energy measurements are correct. Since the Shark® 200 meter is a traceable revenue meter, it contains a utility grade test pulse that can be used to gate an accuracy standard. This is an essential feature required of all billing grade meters.

- Refer to Figure 6.5 for an example of how this process works.
- Refer to Table 6.1 for the Wh/Pulse constants for accuracy testing.

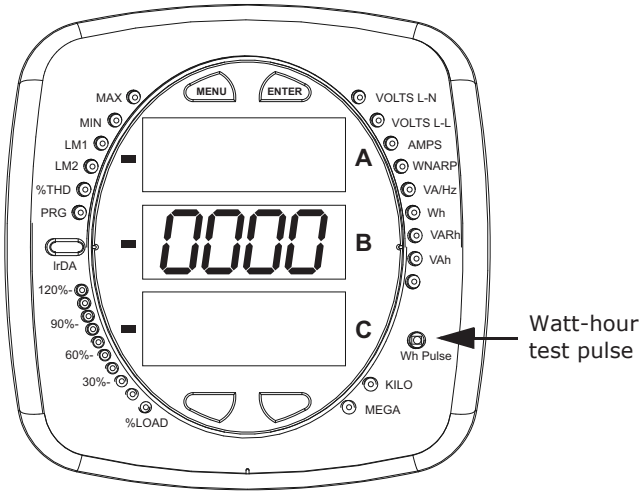



Figure 6.4: Watt-hour Test Pulse

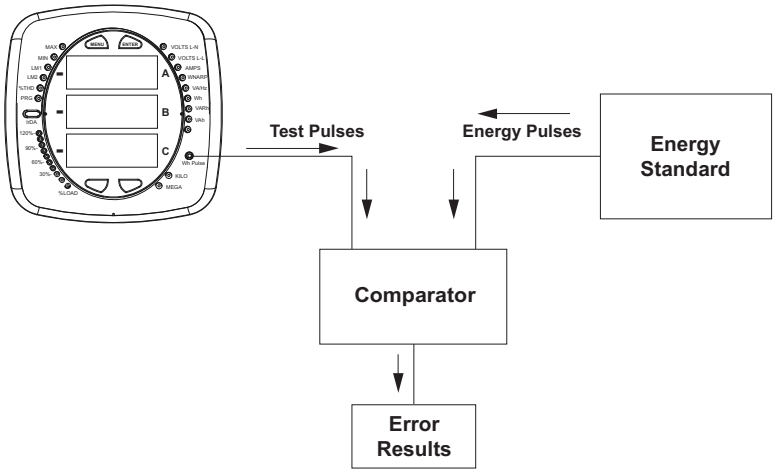



Figure 6.5: Using the Watt-hour Test Pulse

| Input Voltage Level | Class 10 Models | Class 2 Models |
|---|---|---|
| Below 150V | 0.500017776 | 0.1000035555 |
| Above 150V | 2.000071103 | 0.400014221 |

Table 6.1: Infrared & KYZ Pulse Constants for Accuracy Testing - Kh Watt-hour per pulse

**NOTES:**

- Minimum pulse width is 90 milliseconds.
- Refer to Chapter 2, Section 2.2, for Wh Pulse specifications.

# 7: Using the I/O Option Cards

## 7.1: Overview

The Shark® 200 meter offers extensive I/O expandability. Using the two universal Option Card slots, the unit can be easily configured to accept new I/O Option cards even after installation, without your needing to remove the meter. The Shark® 200 meter auto-detects any installed Option cards. Up to 2 cards of any type outlined in this chapter can be used per meter.

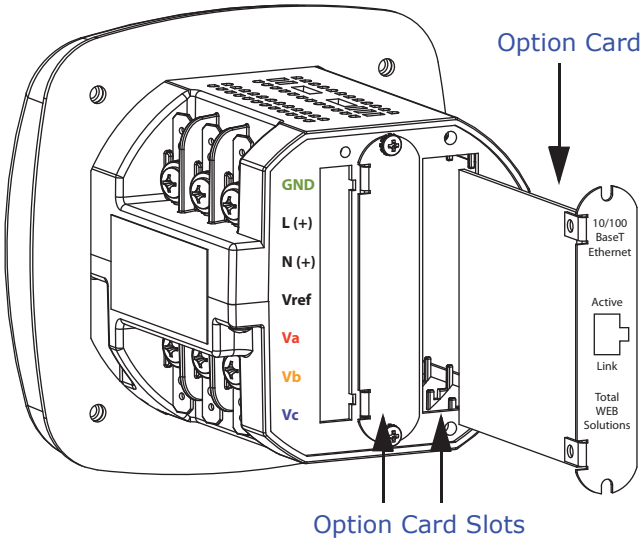



Figure 7.1: Shark® 200 Meter Back, Showing Option Card Slots and I/O Card

## 7.2: Installing Option Cards

The Option cards are inserted in one of the two Option Card slots in the back of the Shark® 200 meter.

**NOTE:** Remove Voltage inputs and power supply terminal to the meter before performing card installation.

1. Remove the screws at the top and the bottom of the Option Card slot covers.

2. There is a plastic "track" on the top and the bottom of the slot. The Option card fits into this track.

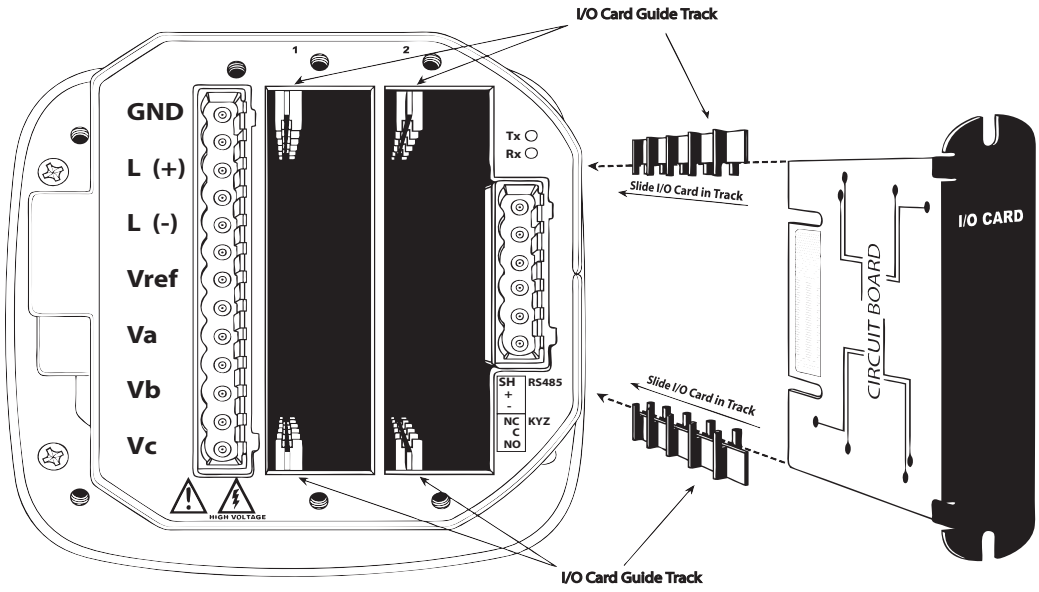



Figure 7.2: Detail of Guide Track

**For safety, remove ALL these connections before installing Option cards: GND, L+, L-, Vref, Va, Vb, Vc.**

3. Slide the card inside the plastic track and insert it into the slot. You will hear a click when the card is fully inserted. Be careful, it is easy to miss the guide track.

4. Securely re-fasten the screws at the top and bottom of the card.

**CAUTIONS!**

- Make sure the I/O card is inserted properly into the track to avoid damaging the card's components.

- For proper card fit, and to avoid damaging the unit, insert components in the following order:
    a. Option card 1
    b. Option card 2
    c. Detachable terminal block 1
    d. Detachable terminal block 2
    e. Communication connection for Port 2

## 7.3: Configuring Option Cards

**CAUTION! FOR PROPER OPERATION, RESET ALL PARAMETERS IN THE UNIT AFTER HARDWARE MODIFICATION.**

The Shark® 200 meter auto-detects any Option cards installed in it. You configure the Option cards through Communicator EXT™ software. Refer to Chapter 5 of the *Communicator EXT™ User Manual* for detailed instructions.

The following sections describe the available Option cards.

## 7.4: 1mA Output Card (1mAOS)

The 1mA card transmits a standardized bi-directional 0-1mA signal. This signal is linearly proportional to real-time quantities measured by the Shark® 200 meter. The outputs are electrically isolated from the main unit.

### 7.4.1: Specifications:

**The technical specifications at 25° C at 5kΩ load are as follows:**

| | |
|---|---|
| Number of outputs: | 4 single ended |
| Power consumption: | 1.2W internal |
| Signal output range: | (-1.2 to +1.2)mA |
| Max. load impedance: | 10k |
| Hardware resolution: | 12 bits |
| Effective resolution: | 14 bits with 2.5kHz PWM |
| Update rate per channel: | 100ms |
| Output accuracy: | ± 0.1 % of output range (2.4mA) |
| Load regulation | ± 0.06 % of output range (2.4mA) load step of 5k @ ± 1mA |
| Temperature coefficient | ± 30nA/° C |
| Isolation: | AC 2500V system to outputs |
| Reset/Default output value: | 0mA |

**The general specifications are as follows:**

| | |
|---|---|
| Operating temperature: | (-20 to +70)° C |
| Storage temperature: | (-40 to +80)° C |
| Relative air humidity: | Maximum 95%, non-condensing |
| EMC - Immunity Interference: | EN61000-4-2 |
| Weight: | 1.6oz |
| Dimensions (inch) W x H x L: | 0.72 x 2.68 x 3.26 |
| External connection: | AWG 12-26/(0.29 - 3.31) $mm^2$ |
| | 5 pin, 0.200” pluggable terminal block |

### 7.4.2: Default Configuration:

The Shark® 200 meter automatically recognizes the installed Option card during power up. If you have not programmed a configuration for the card, the unit defaults to the following outputs:

| | |
|---|---|
| Channel 1 | +Watts, +1800 Watts => +1mA |
| | -Watts, - 1800 Watts => -1mA |
| Channel 2 | +VARs, +1800 VARs => +1mA |
| | - VARs, -1800 VARs => -1mA |
| Channel 3 | Phase A Voltage WYE, 300 Volts => +1mA |
| | Phase A Voltage Delta, 600 Volts => +1mA |
| Channel 4 | Phase A Current, 10 Amps => +1mA |

### 7.4.3: Wiring Diagram

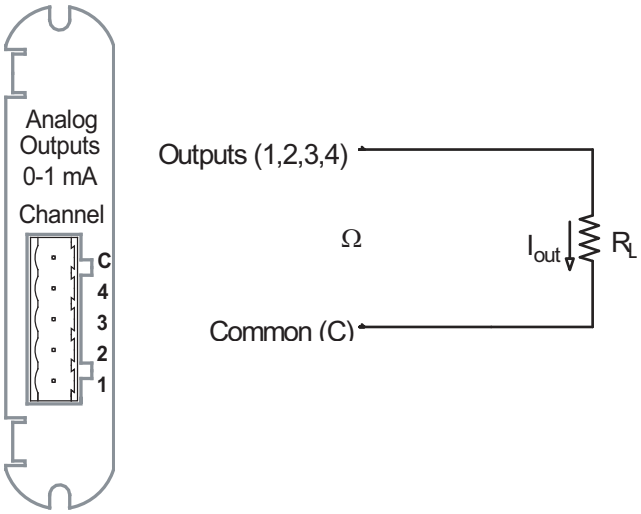



Figure 7.3: 4-Channel 0 - 1mA Output Card

## 7.5: 20mA Output Card (20mAOS)

The 20mA card transmits a standardized 0-20 mA signal. This signal is linearly proportional to real-time quantities measured by the Shark® 200 meter. The current sources need to be loop powered. The outputs are electrically isolated from the main unit.

### 7.5.1: Specifications

**The technical specifications at 25° C at 500Ω load are as follows:**

| | |
|---|---|
| Number of outputs: | 4 single ended |
| Power consumption: | 1W internal |
| Signal output range: | (0 to 24)mA |
| Max. load impedance: | 850 @ 24VDC |
| Hardware resolution: | 12 bits |
| Effective resolution: | 14 bits with 2.5kHz PWM |
| Update rate per channel: | 100ms |
| Output accuracy: | ± 0.1% of output range (24mA) |
| Load regulation: | ± 0.03% of output range (24mA) load step of 200 @ 20mA |
| Temperature coefficient | ± 300n A/°C |
| Isolation: | AC 2500V system to outputs |
| Maximum loop voltage: | 28Vdc max. |
| Internal voltage drop: | 3.4VDC @ 24mA |
| Reset/Default output value: | 12mA |

**The general specifications are as follows:**

| | |
|---|---|
| Operating temperature: | (-20 to +70)° C |
| Storage temperature: | (-40 to +80)° C |
| Relative air humidity: | Maximum 95%, non-condensing |
| EMC - Immunity interference: | EN61000-4-2 |
| Weight: | 1.6oz |
| Dimensions (inch) W x H x L: | 0.72 x 2.68 x 3.26 |
| External connection: | AWG 12-26/(0.129 - 3.31)$mm^2$ |
| | 5 pin, 0.200” pluggable terminal block |

### 7.5.2: Default Configuration:

The Shark® 200 meter automatically recognizes the installed Option card during power up. If you have not programmed a configuration for the card, the unit defaults to the following outputs:

| | |
|---|---|
| Channel 1 | +Watts, +1800 Watts => 20mA |
| | -Watts, -1800 Watts => 4mA |
| | 0 Watts => 12mA |
| Channel 2 | +VARs, +1800 VARs => 20mA |
| | - VARs, -1800 VARs => 4mA |
| | 0 VARs => 12mA |
| Channel 3 | Phase A Voltage WYE, 300 Volts => 20mA |
| | 0 Volts => 4 mA |
| | Phase A Voltage Delta, 600 Volts => 20mA |
| Channel 4 | Phase A Current, 10 Amps => 20mA |
| | 0 Phase A Current, 0 Amps => 4 mA |

### 7.5.3: Wiring Diagram

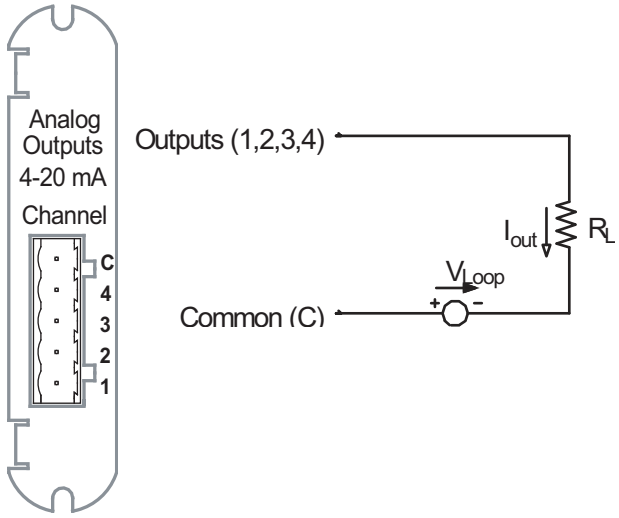



Figure 7.4: 4-Channel 0 - 20mA Output Card

## 7.6: Digital Output (Relay Contact) / Digital Input Card (RO1S)

The Digital Output/Input card is a combination of relay contact outputs for load switching and dry/wet contact sensing digital inputs. The outputs are electrically isolated from the inputs and from the main unit.

### 7.6.1: Specifications

**The technical specifications at 25° C are as follows:**

| | |
|---|---|
| Power consumption: | 0.320W internal |
| Relay outputs: | |
| Number of outputs: | 2 |
| Contact type: | Changeover (SPDT) |
| Relay type: | Mechanically latching |
| Switching voltage: | AC 250V / DC 30V |
| Switching power: | 1250VA / 150W |
| Switching current: | 5A |
| Switching rate max.: | 10/s |
| Mechanical life: | $5 \times 10^7$ switching operations |
| Electrical life: | $10^5$ switching operations at rated current |
| Breakdown voltage: | AC 1000V between open contacts |
| Isolation: | AC 3000V / 5000V surge system to contacts |
| Reset/Power down state: | No change - last state is retained |
| Inputs: | |
| Number of Inputs: | 2 |
| Sensing type: | Wet or dry contact status detection |
| Wetting voltage: | DC (12-24)V, internally generated |

| | |
|---|---|
| Input current: | 2.5mA – constant current regulated |
| Minimum input voltage: | 0V (input shorted to common) |
| Maximum input voltage: | DC 150V (diode protected against polarity reversal) |
| Filtering: | De-bouncing with 50ms delay time |
| Detection scan rate: | 100ms |
| Isolation: | AC 2500V system to inputs |

**The general specifications are as follows:**

| | |
|---|---|
| Operating temperature: | (-20 to +70)° C |
| Storage temperature: | (-40 to +80)° C |
| Relative air humidity: | Maximum 95%, non-condensing |
| EMC - Immunity Interference: | EN61000-4-2 |
| Weight: | 1.5oz |
| Dimensions (inch) W x H x L: | 0.72 x 2.68 x 3.26 |
| External Connection: | AWG 12-26/(0.129 - 3.31)$mm^2$ |
| | 9 pin, 0.200” pluggable terminal block |

### 7.6.2: Wiring Diagram

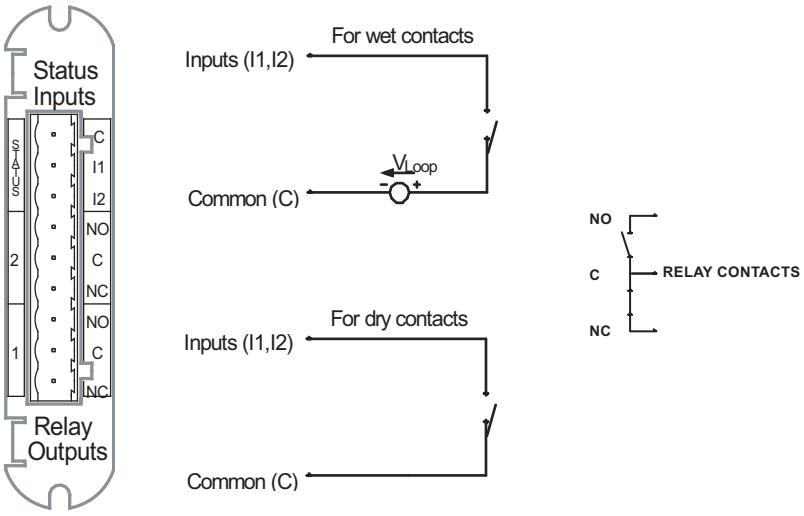



Figure 7.5: Relay Contact (2) / Status Input (2) Card

## 7.7: Pulse Output (Solid State Relay Contacts) / Digital Input Card (P01S)

The Pulse Output/Digital Input card is a combination of pulse outputs via solid state contacts and dry/wet contact sensing digital inputs. The outputs are electrically isolated from the inputs and from the main unit.

### 7.7.1: Specifications

**The technical specifications at 25° C are as follows:**

| | |
|---|---|
| Power consumption: | 0.420W internal |
| Relay outputs: | |
| Number of outputs: | 4 |
| Contact type: | Closing (SPST - NO) |
| Relay type: | Solid state |
| Peak switching voltage: | DC ±350V |
| Continuous load current: | 120mA |
| Peak load current: | 350mA for 10ms |
| On resistance, max.: | 35 |
| Leakage current: | 1µA@350V |
| Switching Rate max.: | 10/s |
| Isolation: | AC 3750V system to contacts |
| Reset/Power down state: | Open contacts |
| Inputs: | |
| Number of inputs: | 4 |
| Sensing type: | Wet or dry contact status detection |
| Wetting voltage: | DC (12-24)V, internally generated |
| Input current: | 2.5mA – constant current regulated |

| | |
|---|---|
| Minimum input voltage: | 0V (input shorted to common) |
| Maximum input voltage: | DC 150V (diode protected against polarity reversal) |
| Filtering: | De-bouncing with 50ms delay time |
| Detection scan rate: | 100ms |
| Isolation: | AC 2500V system to inputs |

**The general specifications are as follows:**

| | |
|---|---|
| Operating Temperature: | (-20 to +70)° C |
| Storage Temperature: | (-40 to +80)° C |
| Relative air humidity: | Maximum 95%, non-condensing |
| EMC - Immunity Interference: | EN61000-4-2 |
| Weight: | 1.3oz |
| Dimensions (inch) W x H x L: | 0.72 x 2.68 x 3.26 |
| External Connection: | AWG 12-26/(0.129 - 3.31)$mm^2$ |
| | 13 pin, 3.5mm pluggable terminal block |

### 7.7.2: Default Configuration:

The Shark® 200 meter automatically recognizes the installed Option card during power up. If you have not programmed a configuration for the card, the unit defaults to the following outputs:

| | |
|---|---|
| Status Inputs | Defaulted to Status Detect |
| Pulse Outputs | Defaulted to Energy Pulses |
| Pulse Channel 1 | 1.8 +Watt-hours per pulse |
| Pulse Channel 2 | 1.8 -Watt-hours per pulse |

| | |
|---|---|
| Pulse Channel 3 | 1.8 +VAR-hours per pulse |
| Pulse Channel 4 | 1.8 -VAR-hours per pulse |

### 7.7.3: Wiring Diagram

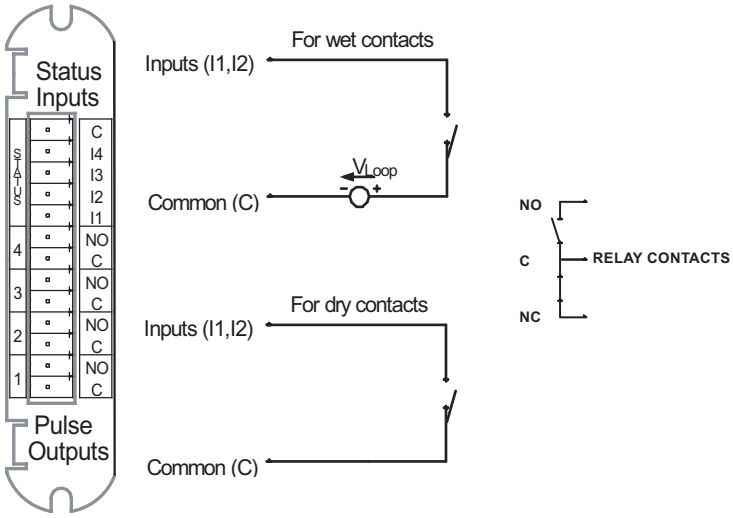



Figure 7.6: Pulse Output (4) / Status Input (4) Card

## 7.8: Fiber Optic Communication Card (FOSTS; FOVPS)

The Fiber Optic Communication card provides a standard serial communication port via a fiber optic connection. An echo switch is available to enable messages bypassing the unit. This feature can be used in a daisy chained network topology.

### 7.8.1: Specifications

**The technical specifications at 25° C are as follows:**

| | |
|---|---|
| Number of Ports: | 1 |
| Power consumption: | 0.160W internal |
| Fiber connection: | ST® (FOST) or Versatile Link (FOVP) – as per order |
| Optical fiber details: | Multimode |
| ST® (FOSTS) | 50/125 µm, 62.5/125 µm, 100/140 µm, |
| | 200µm Hard Clad Silica (HCS®) |
| Versatile Link (FOVPS): | 200µm Hard Clad Silica (HCS®) |
| | 1mm Plastic Optical Fiber (POF) |
| Baud rate: | Up to 57.6kb/s – pre-programmed in the main unit |
| Diagnostic feature: | LED lamps for TX and RX activity |

**The general specifications are as follows:**

| | |
|---|---|
| Operating Temperature: | (-20 to +70)° C |
| Storage Temperature: | (-40 to +80)° C |
| Relative air humidity: | Maximum 95%, non-condensing |
| EMC - Immunity Interference: | EN61000-4-2 |
| Weight: | 1.2oz |
| Dimensions (inch) W x H x L: | 0.72 x 2.68 x 3.26 |

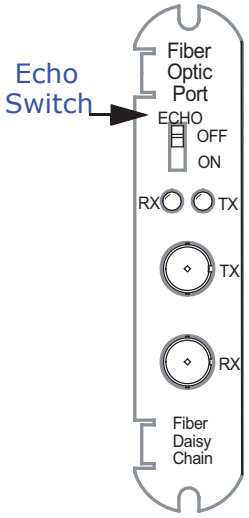
| | |
|---|---|
| Fiber Connection: | ST® (FOST) or Versatile Link (FOVP) – as per order |

HCS® is a registered trademark of SpecTran Corporation.

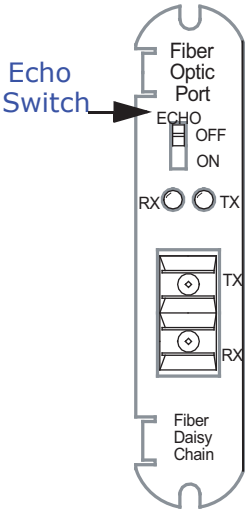
ST® is a registered trademark of AT&T.

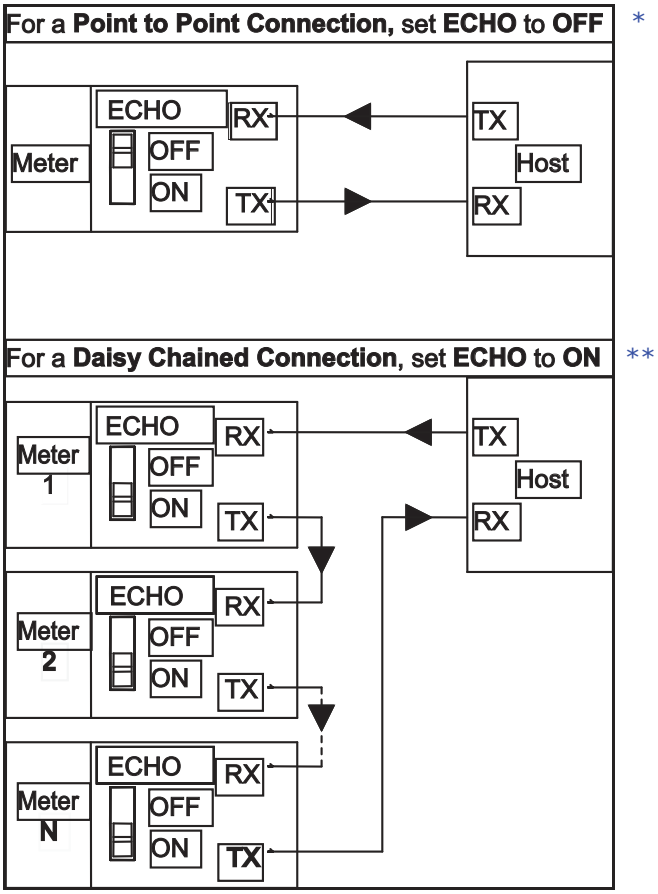
## 7.8.2: Wiring Diagram

ST® type connector




Versatile Link type connector




* When a Fiber Optic Com Card is used in point to point connection, set the Echo Switch to OFF.

**When a Fiber Optic Com Card is installed in a meter that is part of a Daisy Chained connection, set the Echo Switch to ON. This allows messages not for this meter to continue to the next meter in sequence.

Figure 7.7: Fiber Optic Communication Card

## 7.9: 10/100BaseT Ethernet Communication Card (INP100S)

The 10/100BaseT Ethernet Communication card provides the Shark® 200 meter with Ethernet capability. See Chapter 8 for details and instructions.

**NOTE**: Refer to Chapter 5 of the *Communicator EXT™ User Manual* for instructions on performing Network configuration.

### 7.9.1: Specifications

**The technical specifications at 25° C are as follows:**

| | |
|---|---|
| Number of Ports: | 1 |
| Power consumption: | 2.1W internal |
| Baud rate: | 10/100Mbit |
| Diagnostic feature: | Status LEDs for LINK and ACTIVE |
| Number of simultaneous Modbus connections: | 12 |

**The general specifications are as follows:**

| | |
|---|---|
| Operating Temperature: | (-20 to +70)° C |
| Storage Temperature: | (-40 to +80)° C |
| Relative air humidity: | Maximum 95%, non-condensing |
| EMC - Immunity Interference: | EN61000-4-2 |
| Weight: | 1.7oz |
| Dimensions (inch) W x H x L: | 0.72 x 2.68 x 3.26 |
| Connection Type: | RJ45 modular (auto-detecting transmit and receive) |

### 7.9.2: Default Configuration

The Shark® 200 meter automatically recognizes the installed Option card during power up. If you have not programmed a configuration for the card, the unit defaults to the following:

IP Address: 10.0.0.2

Subnet Mask: 255.255.255.0

Default Gateway: 0.0.0.0

### 7.9.3: Wiring Diagram

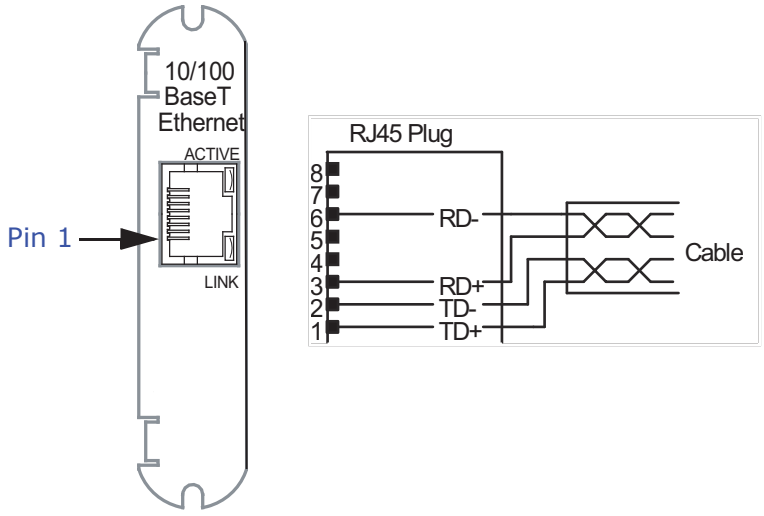



Figure 7.8: 10/100BaseT Ethernet Card

**IMPORTANT!** The INP100S uses an auto-detecting circuit that automatically switches the transmit and receive in order to properly align communication. Because of this, when you are communicating directly to a meter with a PC or a switch, a straight cable can be used.

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# 8: Using the Ethernet Card (INP100S)

## 8.1: Overview

When you install the INP100S in your Shark® 200 meter, you gain the capability of communicating over the Ethernet using EIG's Rapid Response™ technology.

## 8.2: Hardware Connection

The Ethernet card fits into either of the two Option Card slots in the back of the Shark® 200 meter. Refer to Chapter 7 for card installation instructions.

Use a standard RJ45 10/100BaseT cable to connect to the Ethernet card. The INP100S card auto-detects cable type and will work with either straight or crossover cable.

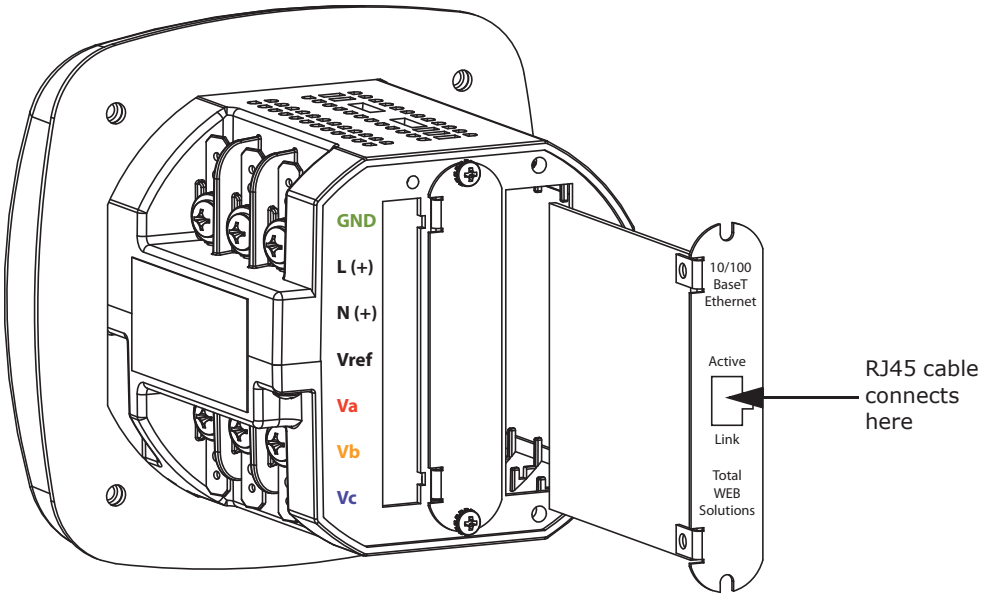



Figure 8.1: Meter with Ethernet Card

## 8.3: Performing Network Configuration

As with the other Option cards, the Shark® 200 meter auto-detects the presence of an installed Ethernet card. Configure the Ethernet card through Communicator EXT™ software. Refer to Chapter 5 of the *Communicator EXT™ User Manual* for instructions. You can open the manual online by clicking **Help>Contents** from the Communicator EXT™ Main screen.

## 8.4: INP100S Ethernet Card Features

The INP100S Ethernet card gives your meter the following capabilities:

- Ethernet communication
- Embedded Web server
- NTP Time Server synchronization

### 8.4.1: Ethernet Communication

The INP100S enables high-speed Ethernet communication with up to 12 simultaneous connections for Modbus TCP. The card supports a static IP address and is treated like a node on the network.

### 8.4.2: Embedded Web Server

The INP100S gives the meter a Web server that is viewable over the Ethernet by almost all browsers. The Shark® Series webpages allow you to see the following information for the Shark® 200 meter:

- Voltage and current readings
- Power and Energy readings
- Power quality information
- General meter information

You can also upgrade the Ethernet (Network) card's firmware from the Meter Information web page.

**Follow these steps to access the Shark® 200 meter's webpages:**

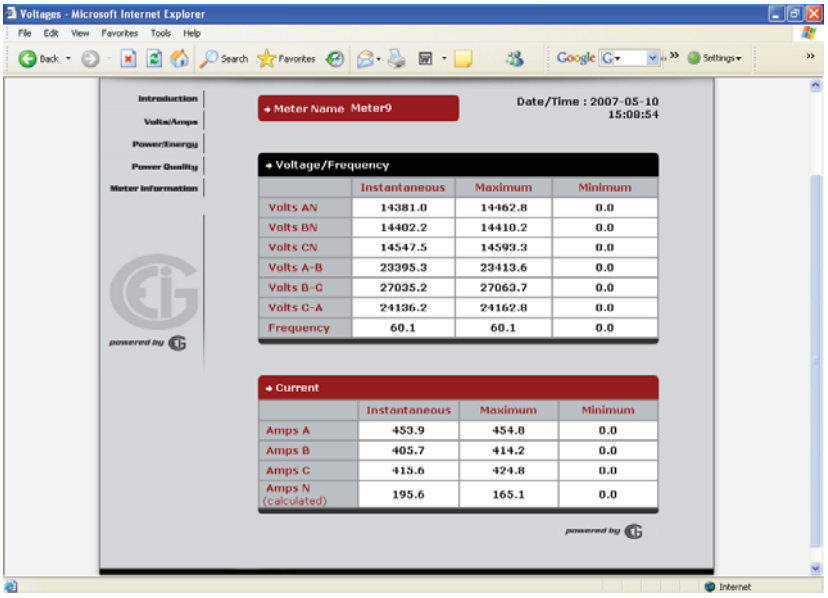
1. Open a standard Web browser from your PC, smart phone, or tablet.

2. Type the Ethernet Card's IP address in the address bar, preceded by "http://".

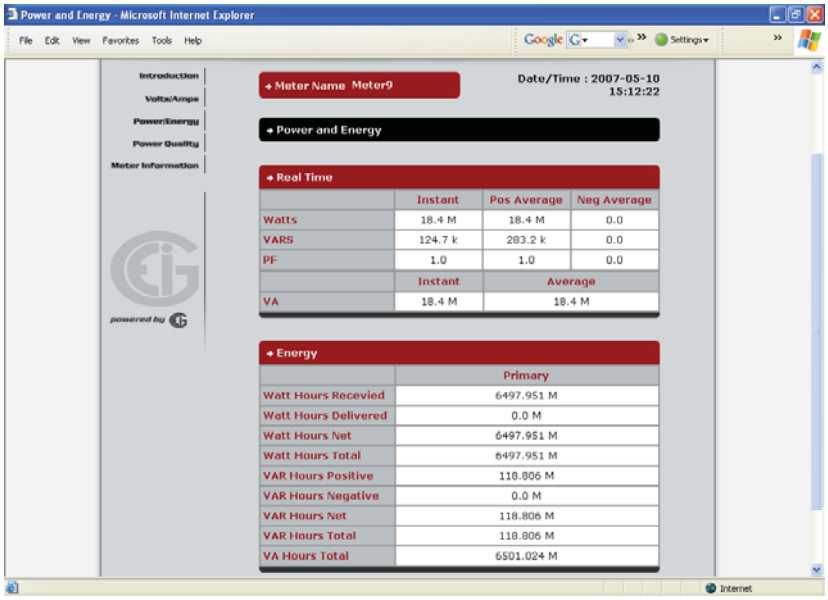
   For example: http://172.20.167.99

3. You will see the Shark® Series Introduction web page shown below.

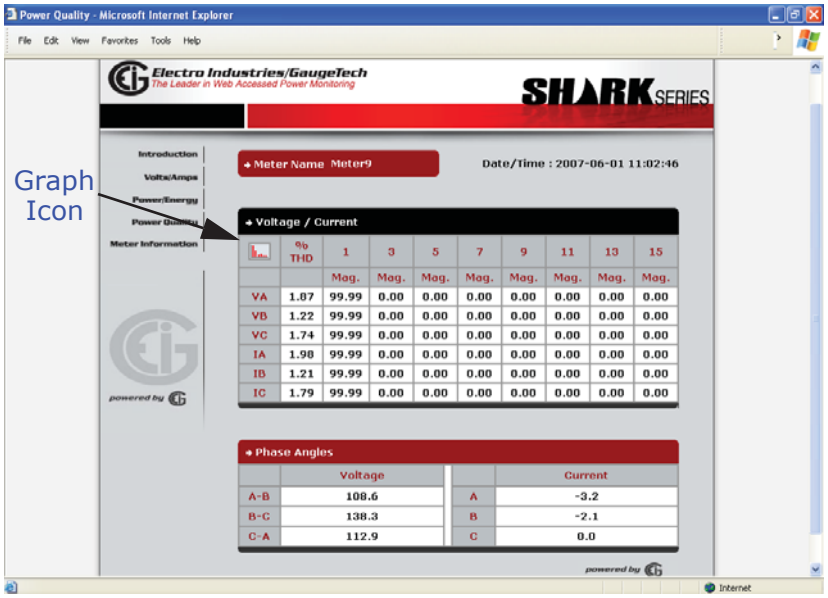
4. To view Voltage and current readings, click **Volts / Amps** on the left side of the web page. You will see the webpage shown below.



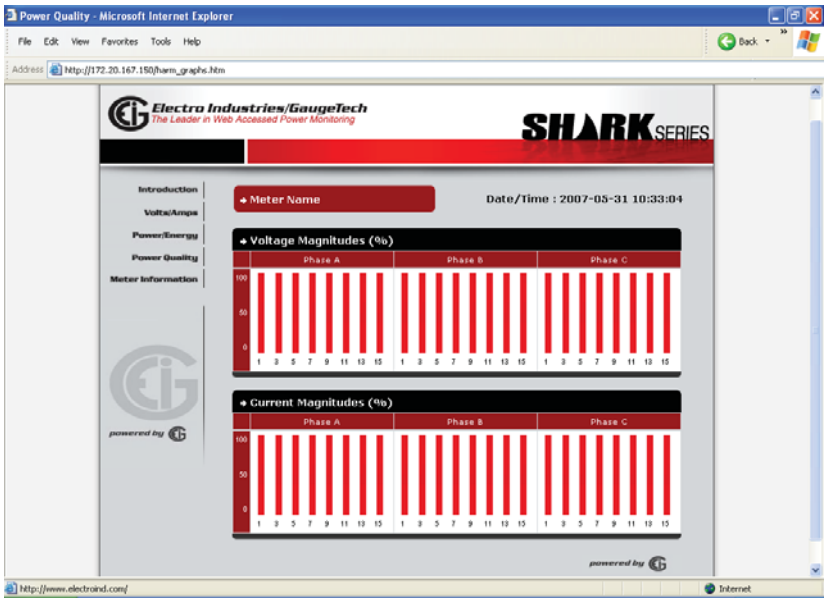
5. To view power and Energy readings, click **Power/Energy** on the left side of the webpage. You will see the webpage shown below.




6. To view power quality information, click **Power Quality** on the left side of the webpage. You will see the webpage shown below

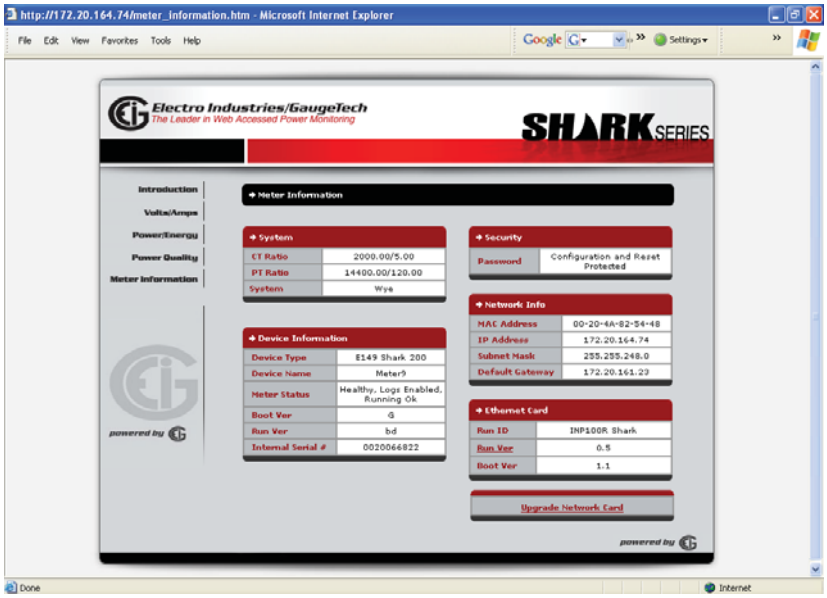


7. To view a graphical representation of the Voltage and current magnitudes, click the **Graph** icon in the corner of the Voltage/Current box. You will see the webpage shown below.




8. Click **Power Quality** on the left side of the webpage to return to the previous webpage.

9. To view meter information, or to upgrade the Network card's firmware, click **Meter Information** on the left side of the webpage. You will see the webpage shown below.



### 8.4.2.1: Upgrading the Ethernet Card's Firmware

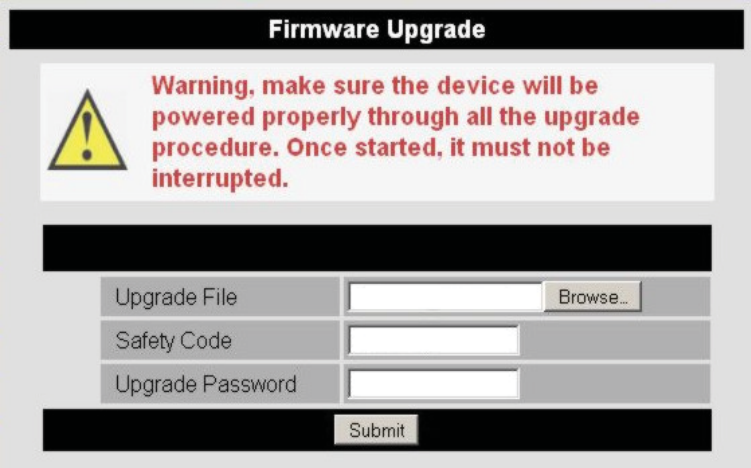
From one of the Shark® 200 meter's webpages:

**NOTE:** This procedure should only be done with a PC running Internet EXplorer.

1. Click **Meter Information** on the left side of the webpage.

2. Click **Upgrade Network Card** (bottom box on the right). You will see the window shown below.

   **NOTE:** In order to upgrade the Network (Ethernet) Card, you must be using the PC on which the upgrade file is stored.


Firmware Upgrade
Warning, make sure the device will be powered properly through all the upgrade procedure. Once started, it must not be interrupted.
Upgrade File
Browse...
Safety Code
Upgrade Password
Submit

3. Click the **Browse** button to locate the Upgrade file.

4. Enter the safety code (supplied with the Upgrade file) and the password: eignet2009.

5. Click **Submit**. The upgrade starts immediately (it may take several minutes to complete). Once the upgrade is complete, you will see a confirmation message.

**CAUTION!** Note the Warning message on the screen. If there is a power interruption during upgrade, please call EIG's Technical Support department at 516-334-0870 for assistance.

### 8.4.3: NTP Time Server Synchronization

The INP100S can be configured to perform time synchronization through a Network Time Protocol (NTP) server. This feature lets you synchronize the Shark® 200 meter's real-time clock with this outside source. See Chapter 5 of the *Communicator EXT*™ *User Manual* for configuration instructions (Configuring the Network Card section). You can view the manual online by clicking **Help>Contents** from the Communicator EXT™ Main screen.

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# 9: Data Logging

## 9.1: Overview

Optional V-Switch™ keys 2-6 (V-2 - V-6) give the Shark® 200 meter additional memory for extensive data logging. The Shark® 200 meter can log historical trends, limit alarms, I/O changes, sequence of events, and waveforms (V-5 and V-6 only). In addition, the meter has a real-time clock that allows all events to be time-stamped when they occur.

## 9.2: Available Logs

The following logs are available for a Shark ® 200 meter equipped with V- 2 - V-4. These meters have 2 MegaBytes of flash memory for data logging.

- Historical Logs: The Shark® 200 meter has three Historical Logs. Each log can be independently programmed with individual trending profiles, that is, each can be used to measure different values. You can program up to 64 parameters per log. You also have the ability to allocate available system resources between the three logs, to increase or decrease the size of the individual historical logs. See Chapter 5 (Configuring Historical Logs and Allocating Historical Log Sectors sections) and Chapter 8 (Viewing Log section) of the *Communicator EXT User Manual* for additional information and instructions.

- Limit/Alarm Log: This log provides the magnitude and duration of events that fall outside of configured acceptable limits. Time stamps and alarm value are provided in the log. Up to 2,048 events can be logged. See Chapter 5 (Configuring Limits section) and Chapter 8 (Shark® 200 Meter Logs section) of the *Communicator EXT User Manual* for additional information and instructions.

- I/O Change Log: This log is unique to the Shark® 200 meter. The I/O Change Log provides a time-stamped record of any Relay Output/Digital Input or Pulse Output/Digital Input Card output or input status changes. Up to 2,048 events can be logged. Refer to Chapter 5 (Configuring Shark® 200 Meter Option Cards section) and Chapter 8 (Shark® 200 Meter Logs section) of the *Communicator EXT User Manual* for additional information and instructions.

- System Events Log: In order to protect critical billing information, the Shark® 200 meter records and logs the following information with a timestamp:

- Demand resets
- Password requests
- System startup
- Energy resets
- Log resets
- Log reads
- Programmable settings changes.

A Shark® 200 meter equipped with V-5 and V-6 has additional memory for data logging: V-5 gives the meter 3 Megabytes of flash memory, and V-6 gives the meter 4 MegaBytes of flash memory. These meters also have waveform recording capabilities, and the following additional log:

- Waveform Log: This event-triggered log records a waveform when a user-programmed value goes out of limit and when the value returns to normal.

All of the Shark® 200 meter Logs can be viewed through the EIG Log Viewer. Refer to Chapter 8 of the *Communicator EXT User Manual* for additional information and instructions regarding Logs and the Log Viewer.

# A: Shark® 200 Meter Navigation Maps

## A.1: Introduction

You can configure the Shark® 200 meter and perform related tasks using the buttons on the meter face. Chapter 6 contains a description of the buttons on the meter face and instructions for programming the meter using them. The meter can also be programmed using software (see Chapter 5 and the *Communicator EXT User Manual*).

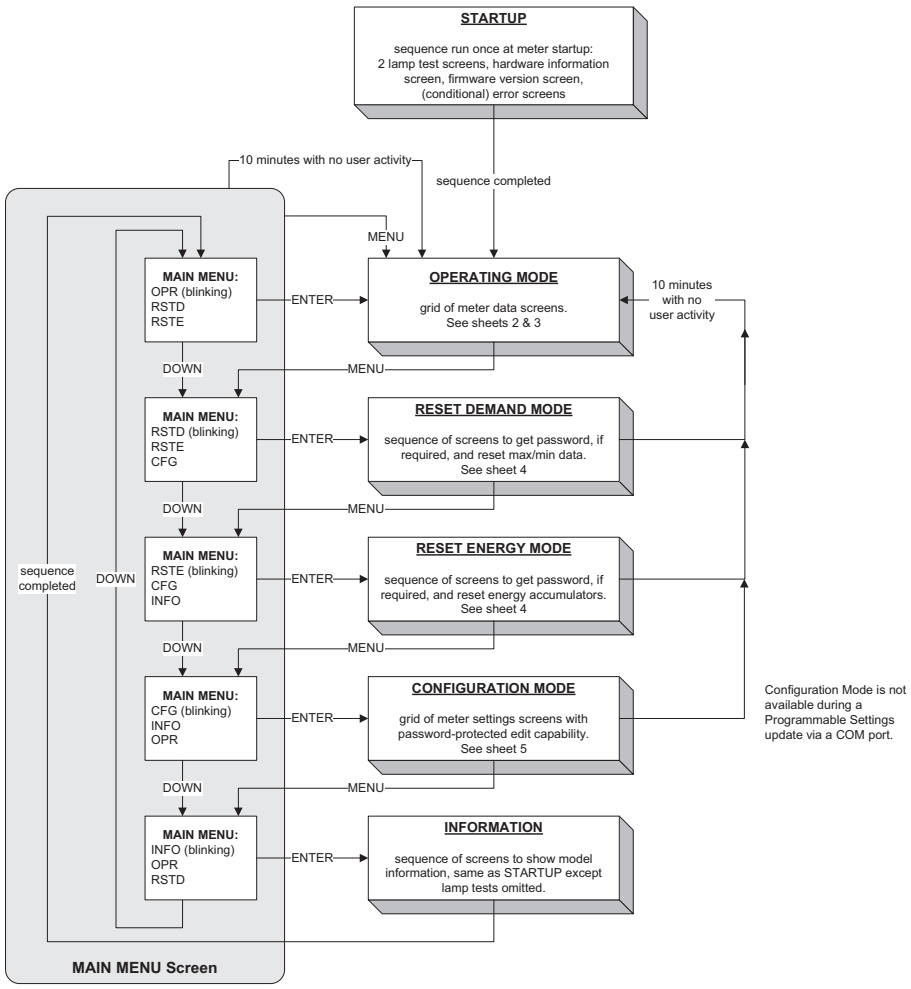
## A.2: Navigation Maps (Sheets 1 to 4)

The Shark® 200 meter's Navigation maps begin on the next page. The maps show in detail how to move from one screen to another and from one Display mode to another using the buttons on the face of the meter. All Display modes automatically return to Operating mode after 10 minutes with no user activity.

**Shark® 200 Meter Navigation Map Titles:**

- Main Menu screens (Sheet 1)
- Operating mode screens (Sheets 2)
- Reset mode screens (Sheet 3)
- Configuration mode screens (Sheet 4)

## Main Menu Screens (Sheet 1)




MAIN MENU screen scrolls through 5 choices, showing 3 at a time. The top choice is always the "active" one, which is indicated by blinking the legend.

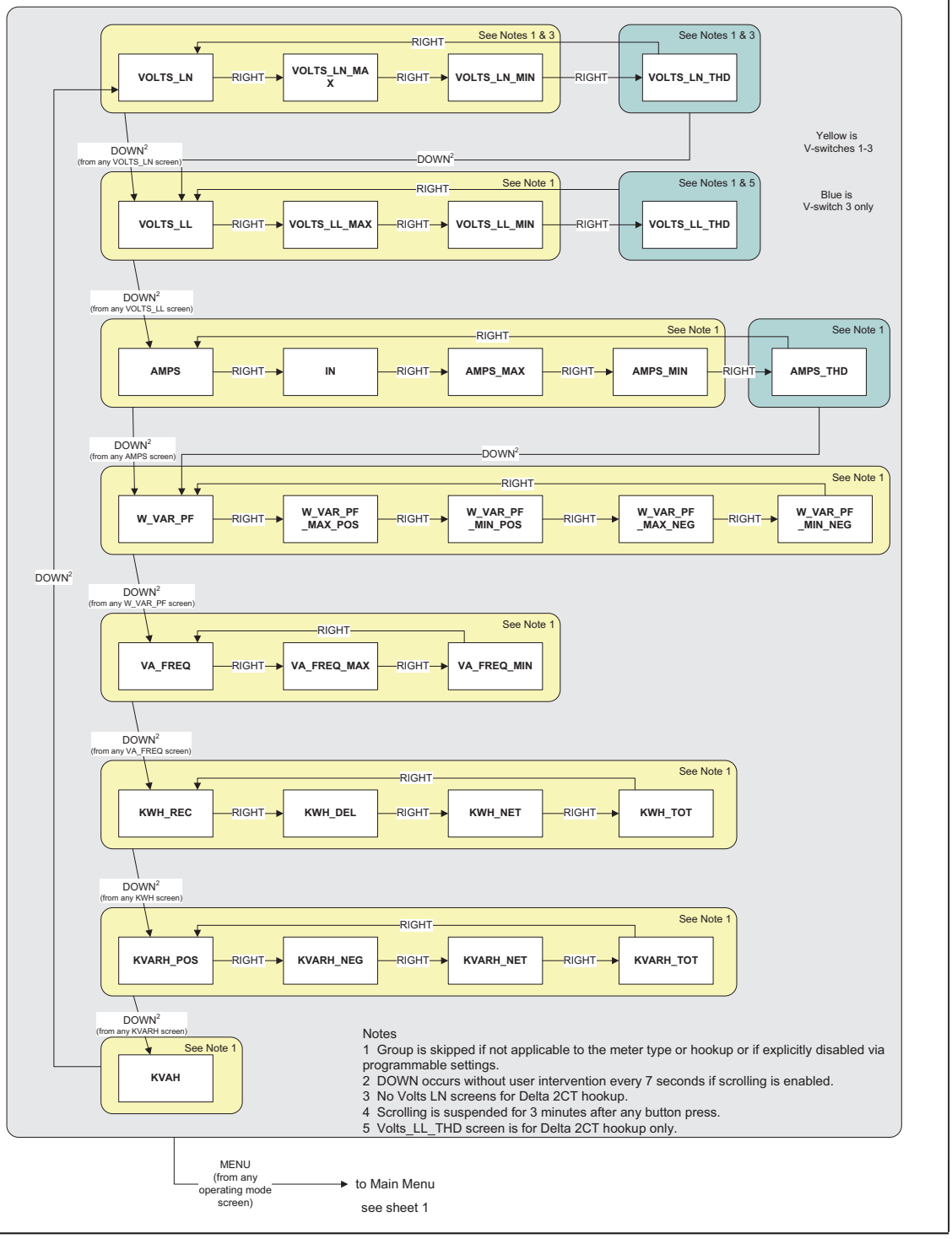
**SYMBOLS**

- single screen
- all screens for a display mode
- group of screens
- action taken
- button →

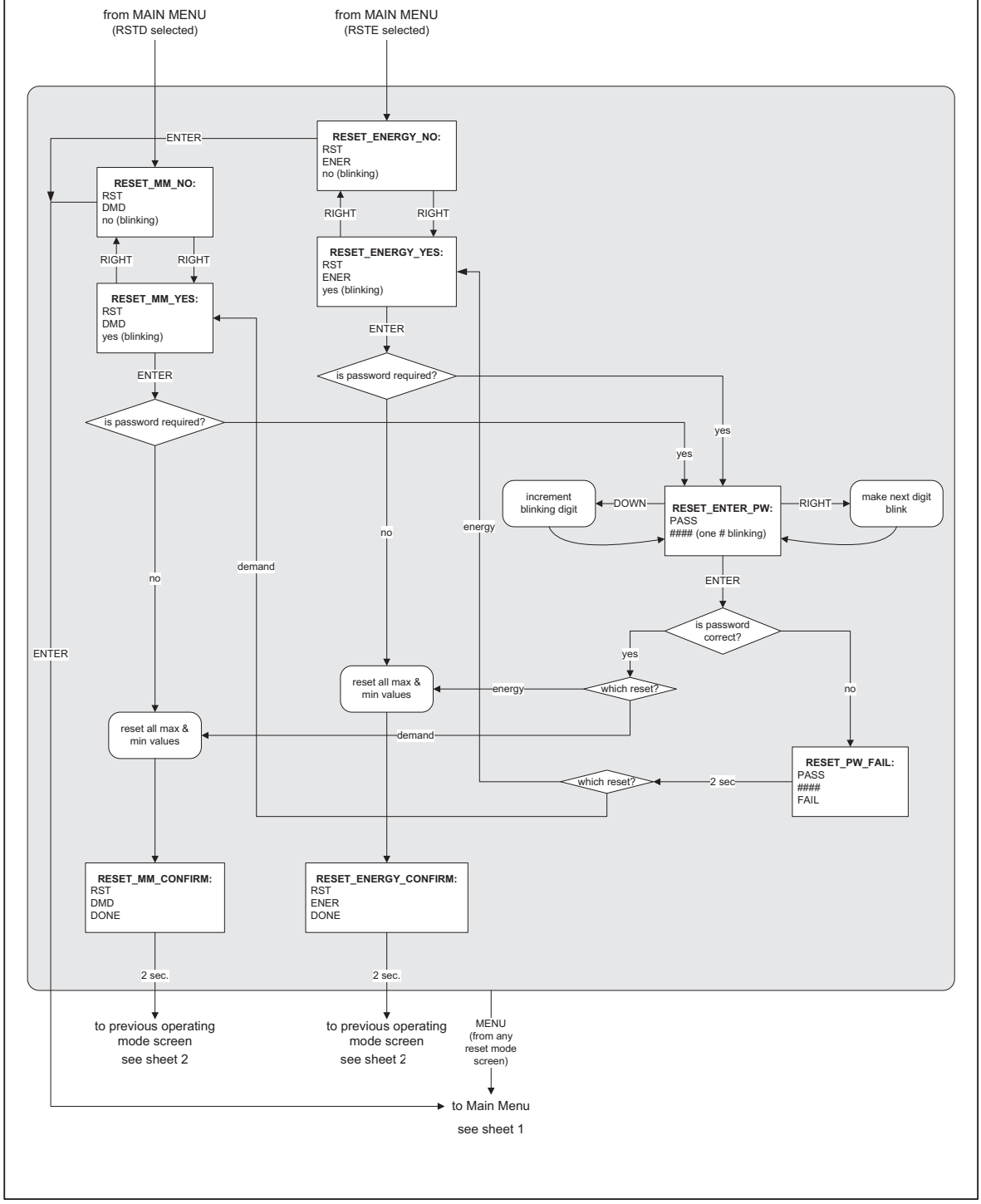
**BUTTONS**

| | |
|---|---|
| MENU | Returns to previous menu from any screen in any mode |
| ENTER | Indicates acceptance of the current screen and advances to the next one |
| DOWN, RIGHT | Navigation and edit buttons |
| Navigation: | No digits or legends are blinking. On a menu, down advances to the next menu selection, right does nothing. In a grid of screens, down advances to the next row, right advances to the next column. Rows, columns, and menus all navigate circularly. |
| Editing: | A digit or legend is blinking to indicate that it is eligible for change. When a digit is blinking, down increases the digit value, right moves to the next digit. When a legend is blinking, either button advances to the next choice legend. |

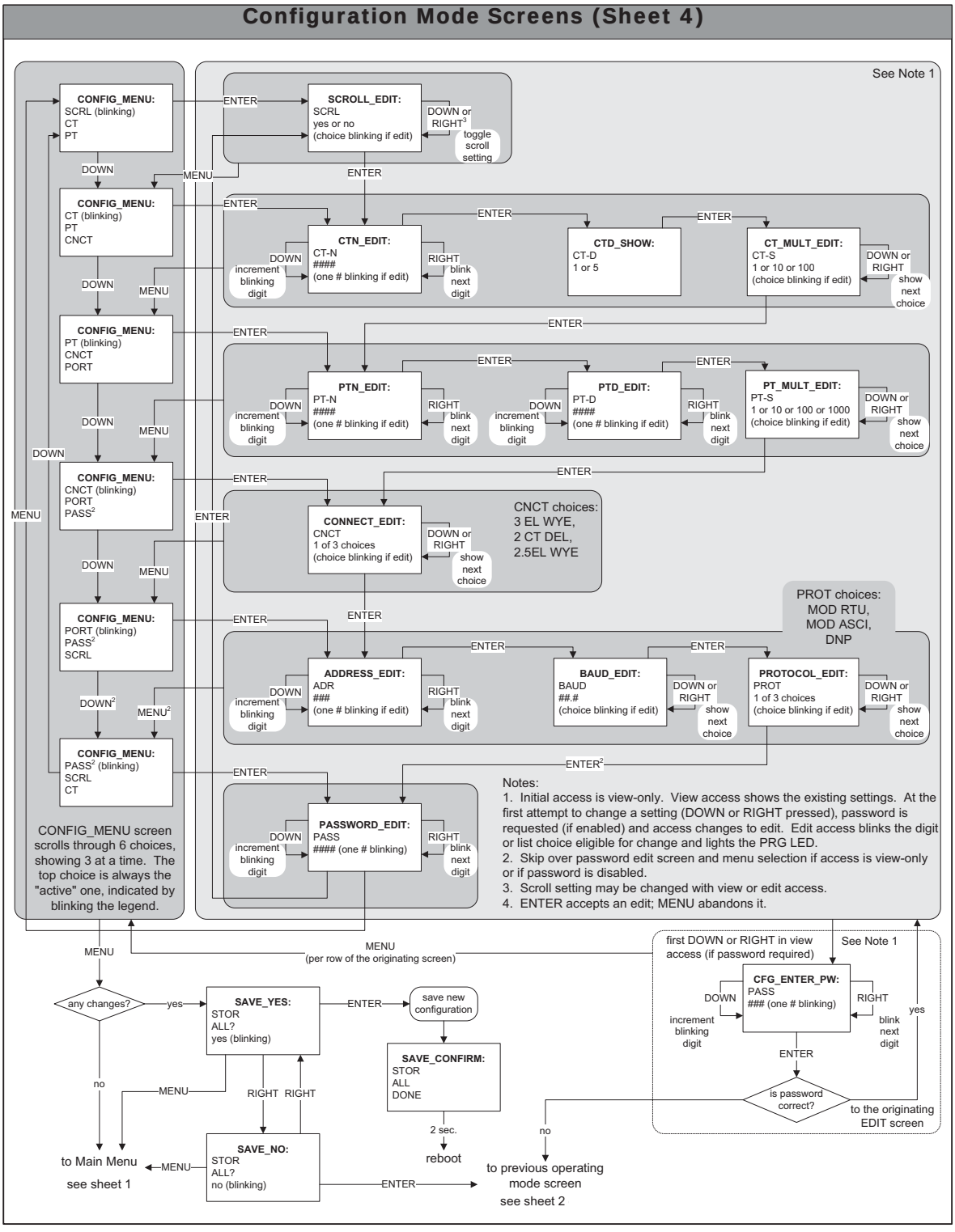
## Operating Mode Screens (Sheet 2)



## Reset Mode Screens (Sheet 3)



## Configuration Mode Screens (Sheet 4)



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# B: Modbus Map and Retrieving Logs

## B.1: Introduction

The Modbus Map for the Shark® 200 meter gives details and information about the possible readings of the meter and its programming. The Shark® 200 meter can be programmed using the buttons on the face of the meter (Chapter 6), or by using software. For a programming overview, see section 5.2 of this manual. For further details see the *Communicator EXT User Manual*.

## B.2: Modbus Register Map Sections

The Shark® 200 meter's Modbus Register Map includes the following sections:

Fixed Data Section, Registers 1- 47, details the Meter's Fixed Information.

Meter Data Section, Registers 1000 - 12031, details the Meter's Readings, including Primary Readings, Energy Block, Demand Block, Phase Angle Block, Status Block, THD Block, Minimum and Maximum in Regular and Time Stamp Blocks, Option Card Blocks, and Accumulators. Operating Mode readings are described in Section 6.2.6.

Commands Section, Registers 20000 - 26011, details the Meter's Resets Block, Programming Block, Other Commands Block and Encryption Block.

Programmable Settings Section, Registers 30000 - 33575, details all the setups you can program to configure your meter.

Secondary Readings Section, Registers 40001 - 40100, details the Meter's Secondary Readings.

Log Retrieval Section, Registers 49997 - 51095, details Log Retrieval. See Section B.5 for instructions on retrieving logs.

## B.3: Data Formats

| | |
|---|---|
| ASCII: | ASCII characters packed 2 per register in high, low order and without any termination characters. |
| SINT16/UINT16: | 16-bit signed/unsigned integer. |
| SINT32/UINT32: | 32-bit signed/unsigned integer spanning 2 registers. The lower-addressed register is the |

high order half.

FLOAT: 32-bit IEEE floating point number spanning 2 registers. The lower-addressed register is the high order half (i.e., contains the exponent).

## B.4: Floating Point Values

Floating Point Values are represented in the following format:

| Register | 0 | | | | | | | | 1 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Byte | 0 | | | | | | | | 1 | | | | | | | |
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Meaning | s | e | e | e | e | e | e | e | e | m | m | m | m | m | m | m |
| | m | m | m | m | m | m | m | m | m | m | m | m | m | m | m | m |
| sign | exponent | | | | | | | | mantissa | | | | | | | |

**The formula to interpret a Floating Point Value is:**

$-1^{sign} \times 2^{exponent-127} \times 1.mantissa = 0x0C4E11DB9$

$-1^{sign} \times 2^{137-127} \times 1\cdot 10000100011101101110 01$

$-1 \times 2^{10} \times 1.75871956$

-1800.929

| Register | 0x0C4E1 | | | | | | | | 0x01DB9 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Byte | 0x0C4 | | | | | | | | 0x0E1 | | | | | | | |
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| Meaning | s | e | e | e | e | e | e | e | e | m | m | m | m | m | m | m |
| | m | m | m | m | m | m | m | m | m | m | m | m | m | m | m | m |
| sign | exponent | | | | | | | | mantissa | | | | | | | |
| 1 | 0x089 + 137 | | | | | | | | 0b01100001000111 0110111001 | | | | | | | |

| Register | 0x01D | | | | | | | | 0x0B9v | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Byte | 0x01D | | | | | | | | 0x0B9v | | | | | | | |
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 |

**Formula Explanation:**

C4E11DB9 (hex) 11000100 11100001 00011101 10111001 (binary)

The sign of the mantissa (and therefore the number) is 1, which represents a negative value.

The Exponent is 10001001 (binary) or 137 decimal.

The Exponent is a value in excess 127. So, the Exponent value is 10.

The Mantissa is 11000010001110110111001 binary.

With the implied leading 1, the Mantissa is (1).611DB9 (hex).

The Floating Point Representation is therefore -1.75871956 times 2 to the 10.

Decimal equivalent: -1800.929

**NOTES:**

- Exponent = the whole number before the decimal point.
- Mantissa = the positive fraction after the decimal point.

## B.5: Retrieving Logs Using the Shark® 200 Meter's Modbus Map

This section describes the log interface system of the Shark® 200 meter from a programming point of view. It is intended for Programmers implementing independent drivers for Log Retrieval from the meter. It describes the meaning of the meter's Modbus Registers related to Log Retrieval and Conversion, and details the procedure for retrieving a log's records.

**NOTES:**

- All references assume the use of Modbus function codes 0x03, 0x06, and 0x10, where each register is a 2 byte MSB (Most Significant Byte) word, except where otherwise noted.
- The carat symbol (^) notation is used to indicate mathematical "power." For example, 2^8 means 28; which is 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2, which equals 256.

### B.5.1: Data Formats

Timestamp: Stores a date from 2000 to 2099. Timestamp has a Minimum resolution of 1 second.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Value | Year | Month | Day | Hour | Minute | Second |
| Range | 0-99 (+2000) | 1-12 | 1-31 | 0-23 | 0-59 | 0-59 |
| Mask | 0x7F | 0x0F | 0x1F | 0x1F | 0x3F | 0x3F |

The high bits of each timestamp byte are used as flags to record meter state information at the time of the timestamp. These bits should be masked out, unless needed.

### B.5.2: Shark® 200 Meter Logs

The Shark® 200 meter has 6 logs: System Event, Alarm (Limits), 3 Historical, and I/O Change. Each log is described below.

1. **System Event (0)**: The System Event log is used to store events which happen in, and to, the meter. Events include Startup, Reset Commands, Log Retrievals, etc. The System Event Log Record takes 20 bytes, 14 bytes of which are available when the log is retrieved.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Value | timestamp | | | | | | Group | Event | Mod | Chan | Param1 | Param2 | Param3 | Param4 |

**NOTE:** The complete Systems Events table is shown in Section B.5.5, step 1, on page B-19.

2. **Alarm Log (1):** The Alarm Log records the states of the 8 Limits programmed in the meter.

   - Whenever a limit goes out (above or below), a record is stored with the value that caused the limit to go out.
   - Whenever a limit returns within limit, a record is stored with the "most out of limit" value for that limit while it was out of limit.

The Alarm Log Record uses 16 bytes, 10 bytes of which are available when the log is retrieved.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Value | timestamp | | | | | | direction | limit# | Value% | |

The limit # byte is broken into a type and an ID.

| Bit | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Value | type | 0 | 0 | 0 | 0 | Limit ID | | |

3. **Historical Log 1 (2)**: The Historical Log records the values of its assigned registers at the programmed interval.

**NOTE:** See Section B.5.3, Number 1, for details on programming and interpreting the log.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | - | - | N |
|---|---|---|---|---|---|---|---|---|---|---|
| Value | timestamp | | | | | | values . . . | | | |

4. **Historical Log 2 (3)**: Same as Historical Log 1.

5. **Historical Log 3 (4)**: Same as Historical Log 1.

6. **I/O Change Log (5)**: The I/O Change Log records changes in the input and output of Digital I/O Type Option Cards (Relay and Pulse).

**I/O Change Log tables:**

**Table 1:**

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Value | Timestamp | | | | | | Card 1 Changes | Card 1 States | Card 2 Changes | Card 2 States |

**Card Change Flags:**

| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| Value | Out 4 Change | Out 3 Change | Out 2 Change | Out 1 Change | In 4 Change | In 3 Change | In 2 Change | In 1 Change |

**Card Current States:**

| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| Value | Out 4 State | Out 3 State | Out 2 State | Out 1 State | In 4 State | In 3 State | In 2 State | In 1 State |

## B.5.3: Block Definitions

This section describes the Modbus Registers involved in retrieving and interpreting a Shark® 200 Meter Log. Other sections refer to certain 'values' contained in this section. See the corresponding value in this section for details.

**NOTES:**

- "Register" is the Modbus Register Address in 0-based Hexadecimal notation. To convert it to 1-based decimal notation, convert from hex16 to decimal10 and add 1. For example: 0x03E7 = 1000.
- "Size" is the number of Modbus Registers (2 byte) in a block of data.

**Historical Log Programmable Settings:**

The Historical Logs are programmed using a list of Modbus Registers that will be copied into the Historical Log record. In other words, Historical Log uses a direct copy of the Modbus Registers to control what is recorded at the time of record capture.

To supplement this, the programmable settings for the Historical Logs contain a list of descriptors, which group registers into items. Each item descriptor lists the data type of the item, and the number of bytes for that item. By combining these two lists, the Historical Log record can be interpreted.

For example: Registers 0x03E7 and 0x03E8 are programmed to be recorded by the historical log. The matching descriptor gives the data type as float, and the size as 4 bytes. These registers program the log to record "Primary Readings Volts A-N."

Historical Log Blocks:

Start Register: 0x7917 (Historical Log 1)

0x79D7 (Historical Log 2)

0x7A97 (Historical Log 3)

Block Size: 192 registers per log (384 bytes)

The Historical Log programmable settings are comprised of 3 blocks, one for each log. Each is identical to the others, so only Historical Log 1 is described here. All register addresses in this section are given as the Historical Log 1 address (0x7917).

Each Historical Log Block is composed of 3 sections: The header, the list of registers to log, and the list of item descriptors.

Header:

Registers: 0x7917 - 0x7918

Size: 2 registers

| Byte | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| Value | # Registers | # Sectors | | Interval |

- # Registers: The number of registers to log in the record. The size of the record in memory is [12 + (# Registers x 2)]. The size during normal log retrieval is [6 + (# Registers x 2)]. If this value is 0, the log is disabled. Valid values are {0-117}.
- # Sectors: The number of Flash Sectors allocated to this log. Each sector is 64kb, minus a sector header of 20 bytes. 15 sectors are available for allocation between Historical Logs 1, 2, and 3. The sum of all Historical Logs may be less than 15. If this value is 0, the log is disabled. Valid values are {0-15}.
- Interval: The interval at which the Historical Log's Records are captured. This value is an enumeration:

| | |
|---|---|
| 0x01 | 1 minute |
| 0x02 | 3 minute |
| 0x04 | 5 minute |
| 0x08 | 10 minute |
| 0x10 | 15 minute |
| 0x20 | 30 minute |
| 0x40 | 60 minute |

| | |
|---|---|
| 0x80 | End of Interval (EOI) Pulse* |

* Setting the interval to EOI causes a record to be logged whenever an EOI pulse event is generated. This is most commonly used in conjunction with the Digital I/O Option Cards.

**NOTE:** The interval between records will not be even (fixed), and thus should not be used with programs that expect a fixed interval.

Register List:

| | |
|---|---|
| Registers: | 0x7919 - 0x798D |
| Size: | 1 register per list item, 117 list items |

The Register List controls what Modbus Registers are recorded in each record of the Historical Log. Since many items, such as Voltage, Energy, etc., take up more than 1 register, multiple registers need to be listed to record those items.

For example: Registers 0x03E7 and 0x03E8 are programmed to be recorded by the historical log. These registers program the log to record "Primary Readings Volts A-N."

- Each unused register item should be set to 0x0000 or 0xFFFF to indicate that it should be ignored.
- The actual size of the record, and the number of items in the register list which are used, is determined by the # registers in the header.
- Each register item is the Modbus Address in the range of 0x0000 to 0xFFFF.

Item Descriptor List:

| | |
|---|---|
| Registers: | 0x798E - 0x79C8 |
| Size: | 1 byte per item, 117 bytes (59 registers) |

While the Register List describes what to log, the Item Descriptor List describes how to interpret that information. Each descriptor describes a group of register items, and what they mean.

Each descriptor is composed of 2 parts:

- Type: The data type of this descriptor, such as signed integer, IEEE floating point, etc. This is the high nibble of the descriptor byte, with a value in the range of 0-14. If this value is 0xFF, the descriptor should be ignored.

| | |
|---|---|
| 0 | ASCII: An ASCII string, or byte array |
| 1 | Bitmap: A collection of bit flags |
| 2 | Signed Integer: A 2's Complement integer |
| 3 | Float: An IEEE floating point |
| 4 | Energy: Special Signed Integer, where the value is adjusted by the energy settings in the meter's Programmable Settings. |
| 5 | Unsigned Integer |
| 6 | Signed Integer 0.1 scale: Special Signed Integer, where the value is divided by 10 to give a 0.1 scale. |
| 7-14 | Unused |
| 15 | Disabled: used as end list marker. |

- Size: The size in bytes of the item described. This number is used to determine the pairing of descriptors with register items.

  For example: If the first descriptor is 4 bytes, and the second descriptor is 2 bytes, then the first 2 register items belong to the 1st descriptor, and the 3rd register item belongs to the 2nd descriptor.

  **NOTE:** As can be seen from the example, above, there is not a 1-to-1 relation between the register list and the descriptor list. A single descriptor may refer to multiple register items.

| **Register Items** | **Descriptors** |
|---|---|
| 0x03C7/<br>0x03C8 | Float, 4 byte |
| 0x1234 | Signed Int, 2 byte |

**NOTE:** The sum of all descriptor sizes must equal the number of bytes in the data portion of the Historical Log record.

Log Status Block:

The Log Status Block describes the current status of the log in question. There is one header block for each of the logs. Each log's header has the following base address:

| Log | Base Address |
|---|---|
| Alarms: | 0xC737 |
| System: | 0xC747 |
| Historical 1: | 0xC757 |
| Historical 2: | 0xC767 |
| Historical 3: | 0xC777 |
| I/O Change: | 0xC787 |

| Bytes | Value | Type | Range | # Bytes |
|---|---|---|---|---|
| 0-3 | Max Records | UINT32 | 0 to 4,294,967,294 | 4 |
| 4-7 | Number of Records Used | UINT32 | 1 to 4,294,967,294 | 4 |
| 8-9 | Record Size in Bytes | UINT16 | 4 to 250 | 2 |
| 10-11 | Log Availability | UINT16 | | 2 |
| 12-17 | Timestamp, First Record | TSTAMP | 1Jan2000 - 31Dec2099 | 6 |
| 18-23 | Timestamp, Last Record | TSTAMP | 1Jan2000 - 31Dec2099 | 6 |
| 24-31 | Reserved | | | 8 |

- Max Records: The maximum number of records the log can hold given the record size, and sector allocation. The data type is an unsigned integer from 0 - 2^32.
- Records Used: The number of records stored in the log. This number will equal the Max Records when the log has filled. This value will be set to 1 when the log is reset. The data type is an unsigned integer from 1 - 2^32.

**NOTE:** The first record in every log before it has rolled over is a "dummy" record, filled with all 0xFF's. When the log is filled and rolls over, this record is overwritten.

- Record Size: The number of bytes in this record, including the timestamp. The data type is an unsigned integer in the range of 14 - 242.
- Log Availability: A flag indicating if the log is available for retrieval, or if it is in use by another port.

| | |
|---|---|
| 0 | Log Available for retrieval |
| 1 | In use by COM1 (IrDA) |
| 2 | In use by COM2 (RS485) |
| 3 | In use by COM3 (Option Card 1) |
| 4 | In use by COM4 (Option Card 2) |
| 0xFFFF | Log Not Available - the log cannot be retrieved. This indicates that the log is disabled. |

**NOTE:** To query the port by which you are currently connected, use the Port ID register:

| | |
|---|---|
| Register: | 0x1193 |
| Size: | 1 register |

Description: A value from 1-4, which enumerates the port that the requestor is currently connected on.

**NOTES:**

- When Log Retrieval is engaged, the Log Availability value will be set to the port that engaged the log. The Log Availability value will stay the same until either the log has been disengaged, or 5 minutes have passed with no activity. It will then reset to 0 (available).
- Each log can only be retrieved by one port at a time.
- Only one log at a time can be retrieved.

- First Timestamp: Timestamp of the oldest record.
- Last Timestamp: Timestamp of the newest record.

Log Retrieval Block:

The Log Retrieval Block is the main interface for retrieving logs. It is comprised of 2 parts: the header and the window. The header is used to program the particular data the meter presents when a log window is requested. The window is a sliding block of data that can be used to access any record in the specified log.

**Session Com Port**: The Shark® 200 meter's Com Port which is currently retrieving logs. Only one Com Port can retrieve logs at any one time.

| | |
|---|---|
| Registers: | 0xC34E - 0xC34E |
| Size: | 1 register |
| 0 | No Session Active |
| 1 | COM1 (IrDA) |
| 2 | COM2 (RS-485) |
| 3 | COM3 (Communications Capable Option Card 1) |
| 4 | COM4 (Communications Capable Option Card 2) |

To get the current Com Port, see the NOTE on querying the port, on the previous page.

**Log Retrieval Header:**

The Log Retrieval Header is used to program the log to be retrieved, the record(s) of that log to be accessed, and other settings concerning the log retrieval.

| | |
|---|---|
| Registers: | 0xC34F - 0xC350 |
| Size: | 2 registers |

| Bytes | Value | Type | Format | Description | # Bytes |
|---|---|---|---|---|---|
| 0-1 | Log Number, Enable, Scope | UINT16 | nnnnnnnn essssssss | nnnnnnnn - log to retrieve, e - retrieval session enable ssssssss - retrieval mode | 2 |
| 2-3 | Records per Window, Number of Repeats | UINT16 | wwwwwwww nnnnnnnn | wwwww-www - records per window, nnnnnnnn - repeat count | 2 |

- Log Number: The log to be retrieved. Write this value to set which log is being retrieved.

| | |
|---|---|
| 0 | System Events |
| 1 | Alarms |
| 2 | Historical Log 1 |
| 3 | Historical Log 2 |
| 4 | Historical Log 3 |
| 5 | I/O Change Log |

- Enable: This value sets if a log retrieval session is engaged (locked for retrieval) or disengaged (unlocked, read for another to engage). Write this value with 1(enable) to begin log retrieval. Write this value with 0(disable) to end log retrieval.

| | |
|---|---|
| 0 | Disable |
| 1 | Enable |

- Scope: Sets the amount of data to be retrieved for each record. The default should be 0 (normal).

| | |
|---|---|
| 0 | Normal |

| | |
|---|---|
| 1 | Timestamp Only |
| 2 | Image |

- Normal [0]: The default record. Contains a 6-byte timestamp at the beginning, then N data bytes for the record data.
- Timestamp [1]: The record only contains the 6-byte timestamp. This is most useful to determine a range of available data for non-interval based logs, such as Alarms and System Events.
- Image [2]: The full record, as it is stored in memory. Contains a 2-byte checksum, 4-byte sequence number, 6-byte timestamp, and then N data bytes for the record data.

- Records Per Window: The number of records that fit evenly into a window. This value is set-able, as less than a full window may be used. This number tells the retrieving program how many records to expect to find in the window.

  (RecPerWindow x RecSize) = #bytes used in the window.

  This value should be ((123 x 2) \ recSize), rounded down.

  For example, with a record size of 30, the RecPerWindow = ((123 x 2) \ 30) = 8.2 ~= 8

- Number of Repeats: Specifies the number of repeats to use for the Modbus Function Code 0x23 (35). Since the meter must pre-build the response to each log window request, this value must be set once, and each request must use the same repeat count. Upon reading the last register in the specified window, the record index will increment by the number of repeats, if auto-increment is enabled. Section B.5.4.2 has additional information on Function Code 0x23.

| | |
|---|---|
| 0 | Disables auto-increment |
| 1 | No Repeat count, each request will only get 1 window. |
| 2-8 | 2-8 windows returned for each Function Code 0x23 request. |

| Bytes | Value | Type | Format | Description | # Bytes |
|---|---|---|---|---|---|
| 0-3 | Offset of First Record in Window | UINT32 | ssssssss nnnnnnnn nnnnnnnn nnnnnnnn | ssssssss - window status nn…nn - 24-bit record index number. | 4 |
| 4-249 | Log Retrieve Window | UINT16 | | | 246 |

**Log Retrieval Window Block:**

The Log Retrieval Window block is used to program the data you want to retrieve from the log. It also provides the interface used to retrieve that data.

Registers: 0xC351 - 0xC3CD

Size: 125 registers

- Window Status: The status of the current window. Since the time to prepare a window may exceed an acceptable modbus delay (1 second), this acts as a state flag, signifying when the window is ready for retrieval. When this value indicates that the window is not ready, the data in the window should be ignored. Window Status is Read-only, any writes are ignored.

  0 Window is Ready

  0xFF Window is Not Ready

- Record Number: The record number of the first record in the data window. Setting this value controls which records will be available in the data window.

  - When the log is engaged, the first (oldest) record is "latched." This means that record number 0 will always point to the oldest record at the time of latching, until the log is disengaged (unlocked).

  - To retrieve the entire log using auto-increment, set this value to 0, and retrieve the window repeatedly, until all records have been retrieved.

**NOTES:**

- When auto-increment is enabled, this value will automatically increment so that the window will "page" through the records, increasing by RecordsPerWindow each time that the last register in the window is read.
- When auto-increment is not enabled, this value must be written-to manually, for each window to be retrieved.

- Log Retrieval Data Window: The actual data of the records, arranged according to the above settings.

### B.5.4: Log Retrieval

Log Retrieval is accomplished in 3 basic steps:

1. Engage the log.
2. Retrieve each of the records.
3. Disengage the log.

#### B.5.4.1: Auto-Increment

In EIG's traditional Modbus retrieval system, you write the index of the block of data to retrieve, then read that data from a buffer (window). To improve the speed of retrieval, the index can be automatically incremented each time the buffer is read.

In the Shark® 200 meter, when the last register in the data window is read, the record index is incremented by the Records per Window.

#### B.5.4.2: Modbus Function Code 0x23

**QUERY**

| Field Name | Example (Hex) |
|---|---|
| Slave Address | 01 |
| Function | 23 |
| Starting Address Hi | C3 |
| Starting Address Lo | 51 |

| | |
|---|---|
| # Points Hi | 00 |
| # Points Lo | 7D |
| Repeat Count | 04 |

Function Code 0x23 is a user defined Modbus function code, which has a format similar to Function Code 0x03, except for the inclusion of a "repeat count." The repeat count (RC) is used to indicate that the same N registers should be read RC number of times. (See the Number of Repeats bullet on page B-14.)

**NOTES:**

- By itself this feature would not provide any advantage, as the same data will be returned RC times. However, when used with auto-incrementing, this function condenses up to 8 requests into 1 request, which decreases communication time, as fewer transactions are being made.
- In the Shark® 200 meter repeat counts are limited to 8 times for Modbus RTU, and 4 times for Modbus ASCII.

The response for Function Code 0x23 is the same as for Function Code 0x03, with the data blocks in sequence.

**IMPORTANT!** Before using function code 0x23, always check to see if the current connection supports it. Some relay devices do not support user defined function codes; if that is the case, the message will stall. Other devices don't support 8 repeat counts.

### B.5.4.3: Log Retrieval Procedure

The following procedure documents how to retrieve a single log from the oldest record to the newest record, using the "normal" record type (see **Scope**). All logs are retrieved using the same method. See Section B.5.4.4 for a Log Retrieval example.

**NOTES:**

- This example uses auto-increment.
- In this example, Function Code 0x23 is not used.
- You will find referenced topics in Section B.5.3. Block Definitions.

- Modbus Register numbers are listed in brackets.

1. Engage the Log:

   a. Read the Log Status Block.

      i.. Read the contents of the specific logs' status block [0xC737+, 16 reg] (see Log Headers).

      ii. Store the # of Records Used, the Record Size, and the Log Availability.

      iii. If the Log Availability is not 0, stop Log Retrieval; this log is not available at this time. If Log Availability is 0, proceed to step 1b (Engage the log).

   This step is done to ensure that the log is available for retrieval, as well as retrieving information for later use.

   b. Engage the log: write log to engage to Log Number, 1 to Enable, and the desired mode to Scope (default 0 (Normal)) [0xC34F, 1 reg]. This is best done as a single-register write.

   This step will latch the first (oldest) record to index 0, and lock the log so that only this port can retrieve the log, until it is disengaged.

   c. Verify the log is engaged: read the contents of the specific logs' status block [0xC737+, 16 reg] again to see if the log is engaged for the current port (see Log Availability). If the Log is not engaged for the current port, repeat step 1b (Engage the log).

   d. Write the retrieval information.

      i. Compute the number of records per window, as follows:

      RecordsPerWindow = (246 \ RecordSize)

      - If using 0x23, set the repeat count to 2-8. Otherwise, set it to 1.

      - Since we are starting from the beginning for retrieval, the first record index is 0.

ii. Write the Records per window, the Number of repeats (1), and Record Index (0) [0xC350, 3 reg].

This step tells the Shark® 200 meter what data to return in the window.

2. Retrieve the records:

a. Read the record index and window: read the record index, and the data window [0xC351, 125 reg].

- If the meter Returns a Slave Busy Exception, repeat the request.
- If the Window Status is 0xFF, repeat the request.
- If the Window Status is 0, go to step 2b (Verify record index).

**NOTES:**

- We read the index and window in 1 request to minimize communication time, and to ensure that the record index matches the data in the data window returned.
- Space in the window after the last specified record (RecordSize x Record-PerWindow) is padded with 0xFF, and can be safely discarded.

b. Verify that the record index incremented by Records Per Window. The record index of the retrieved window is the index of the first record in the window. This value will increase by Records Per Window each time the window is read, so it should be 0, N, N x 2, N x 3 . . . for each window retrieved.

- If the record index matches the expected record index, go to step 2c (Compute next expected record index).
- If the record index does not match the expected record index, then go to step 1d (Write the retrieval information), where the record index will be the same as the expected record index. This will tell the Shark® 200 meter to repeat the records you were expecting.

c. Compute next Expected Record Index.

- If there are no remaining records after the current record window, go to step 3 (Disengage the log).
- Compute the next expected record index by adding Records Per Window, to the current expected record index. If this value is greater than the number of records, re-size the window so it only contains the remaining records and go to step 1d (Write the retrieval information), where the Records Per Window will be the same as the remaining records.

3. Disengage the log: write the Log Number (of log being disengaged) to the Log Index and 0 to the Enable bit [0xC34F, 1 reg].

### B.5.4.4: Log Retrieval Example

The following example illustrates a log retrieval session. The example makes the following assumptions:

- Log Retrieved is Historical Log 1 (Log Index 2).
- Auto-Incrementing is used.
- Function Code 0x23 is not used (Repeat Count of 1).
- The Log contains Volts-AN, Volts-BN, Volts-CN (12 bytes).
- 100 Records are available (0-99).
- COM Port 2 (RS485) is being used (see Log Availability).
- There are no Errors.
- Retrieval is starting at Record Index 0 (oldest record).
- Protocol used is Modbus RTU. The checksum is left off for simplicity.
- The Shark® 200 meter is at device address 1.
- No new records are recorded to the log during the log retrieval process.

1. Read [0xC757, 16 reg], Historical Log 1 Header Block.

| | |
|---|---|
| **Send:** | 0103 C757 0010 |
| **Command**: | |
| Register Address: | 0xC757 |
| # Registers: | 16 |

---

| | |
|---|---|
| **Receive**: | 010320 00000100 00000064 0012 0000 060717101511 060718101511 0000000000000000 |
| **Data**: | |
| Max Records: | 0x100 = 256 records maximum. |
| Num Records: | 0x64 = 100 records currently logged. |
| Record Size: | 0x12 = 18 bytes per record. |
| Log Availability: | 0x00 = 0, not in use, available for retrieval. |
| First Timestamp: | 0x060717101511 = July 23, 2006, 16:21:17 |
| Last Timestamp: | 0x060717101511 = July 24, 2006, 16:21:17 |

**NOTE**: This indicates that Historical Log 1 is available for retrieval.

2. Write 0x0280 -> [0xC34F, 1 reg], Log Enable.

| | |
|---|---|
| **Send**: | 0106 C34F 0280 |
| **Command**: | |
| Register Address: | 0xC34F |
| # Registers: | 1 (Write Single Register Command) |
| **Data**: | |
| Log Number: | 2 (Historical Log 1) |

Enable: 1 (Engage log)

Scope: 0 (Normal Mode)

---

**Receive**: 0106C34F0280 (echo)

**NOTE**: This engages the log for use on this COM Port, and latches the oldest record as record index 0.

3. Read [0xC757, 16 reg], Availability is 0.

**Send**: 0103 C757 0010

**Command**:

Register Address: 0xC757

# Registers: 16

---

**Receive**: 010320 00000100 00000064 0012 0002 060717101511 060718101511 0000000000000000

**Data**:

Max Records: 0x100 = 256 records maximum.

Num Records: 0x64 = 100 records currently logged.

Record Size: 0x12 = 18 bytes per record.

Log Availability: 0x02 = 2, In use by COM2, RS485 (the current port)

First Timestamp: 0x060717101511 = July 23, 2006, 16:21:17

Last Timestamp: 0x060717101511 = July 24, 2006, 16:21:17

**NOTE**: This indicates that the log has been engaged properly in step 2. Proceed to retrieve the log.

4. Compute #RecPerWin as (246\18)=13. Write 0x0D01 0000 0000 -> [0xC350, 3 reg] Write Retrieval Info. Set Current Index as 0.

| | |
|---|---|
| **Send**: | 0110 C350 0003 06 0D01 00 000000 |
| **Command**: | |
| Register Address: | 0xC350 |
| # Registers: | 3, 6 bytes |
| **Data**: | |
| Records per Window: | 13. Since the window is 246 bytes, and the record is 18 bytes, 246\18 = 13.66, which means that 13 records evenly fit into a single window. This is 234 bytes, which means later on, we only need to read 234 bytes (117 registers) of the window to retrieve the records. |
| # of Repeats: | 1. We are using auto-increment (so not 0), but not function code 0x23. |
| Window Status: | 0 (ignore) |
| Record Index: | 0, start at the first record. |

---

| | |
|---|---|
| **Receive**: | 0110C3500003 (command ok) |

**NOTES**:

- This sets up the window for retrieval; now we can start retrieving the records.
- As noted above, we compute the records per window as 246\18 = 13.66, which is rounded to 13 records per window. This allows the minimum number of requests to be made to the meter, which increases retrieval speed.

5. Read [0xC351, 125 reg], first 2 reg is status/index, last 123 reg is window data. Status OK.

| | |
|---|---|
| **Send**: | 0103 C351 007D |
| **Command**: | |
| Register Address: | 0xC351 |
| # Registers: | 0x7D, 125 registers |
| --- | |
| **Receive**: | 0103FA 00000000<br>060717101511FFFFFFFFFFFFFFFFFFFFFF<br>06071710160042FAAACF42FAAD1842FAA9A8 . . . |
| **Data**: | |
| Window Status: | 0x00 = the window is ready. |
| Index: | 0x00 = 0, The window starts with the 0'th record, which is the oldest record. |
| Record 0: | The next 18 bytes is the 0'th record (filler). |
| Timestamp: | 0x060717101511, = July 23, 2006, 16:21:17 |
| Data: | This record is the "filler" record. It is used by the meter so that there is never 0 records. It should be ignored. It can be identified by the data being all 0xFF.<br>**NOTE:** Once a log has rolled over, the 0'th record will be a valid record, and the filler record will disappear. |
| Record 1: | The next 18 bytes is the 1'st record. |
| Timestamp: | 0x060717101600 July 23, 2006, 16:22:00 |
| Data: | |
| Volts AN: | 0x42FAAACF, float = 125.33~ |
| Volts BN: | 0x42FAAD18, float = 125.33~ |

Volts CN: 0x42FAA9A8, float = 125.33~

. . . 13 records

**NOTES**:

- This retrieves the actual window. Repeat this command as many times as necessary to retrieve all of the records when auto-increment is enabled.
- Note the filler record. When a log is reset (cleared) in the meter, the meter always adds a first "filler" record, so that there is always at least 1 record in the log. This "filler" record can be identified by the data being all 0xFF, and it being index 0. If a record has all 0xFF for data, the timestamp is valid, and the index is NOT 0, then the record is legitimate.
- When the "filler" record is logged, its timestamp may not be "on the interval." The next record taken will be on the next "proper interval," adjusted to the hour. For example, if the interval is 1 minute, the first "real" record will be taken on the next minute (no seconds). If the interval is 15 minutes, the next record will be taken at :15, :30, :45, or :00 - whichever of those values is next in sequence.

6. Compare the index with Current Index.

**NOTES**:

- The Current Index is 0 at this point, and the record index retrieved in step 5 is 0: thus we go to step 8.
- If the Current Index and the record index do not match, go to step 7. The data that was received in the window may be invalid, and should be discarded.

7. Write the Current Index to [0xC351, 2 reg].

**Send**: 0110 C351 0002 04 00 00000D

**Command**:

Register Address: 0xC351

# Registers: 2, 4 bytes

**Data**:

Window Status: 0 (ignore)

Record Index: 0x0D = 13, start at the 14th record.

---

**Receive**: 0110C3510002 (command ok)

**NOTES**:

- This step manually sets the record index, and is primarily used when an out-of-order record index is returned on a read (step 6).
- The example assumes that the second window retrieval failed somehow, and we need to recover by requesting the records starting at index 13 again.

8. For each record in the retrieved window, copy and save the data for later interpretation.

9. Increment Current Index by RecordsPerWindow.

**NOTES**:

- This is the step that determines how much more of the log we need to retrieve.
- On the first N passes, Records Per Window should be 13 (as computed in step 4), and the current index should be a multiple of that (0, 13, 26, . . .). Thisamount will decrease when we reach the end (see step 10).
- If the current index is greater than or equal to the number of records (in this case 100), then all records have been retrieved; go to step 12. Otherwise, go to step 10 to check if we are nearing the end of the records.

10. If number records - current index < RecordsPerWindow, decrease to match.

**NOTES**:

- Here we bounds-check the current index, so we don't exceed the records available.
- If the number of remaining records (#records - current index) is less than the Records per Window, then the next window is the last, and contains less than a full window of records. Make records per window equal to remaining records

(#records-current index). In this example, this occurs when current index is 91 (the 8'th window). There are now 9 records available (100-91), so make Records per Window equal 9.

11. Repeat steps 5 through 10.

**NOTES**:

- Go back to step 5, where a couple of values have changed.

| Pass | CurIndex | FirstRecIndex | RecPerWindow |
|---|---|---|---|
| 0 | 0 | 0 | 13 |
| 1 | 13 | 13 | 13 |
| 2 | 26 | 26 | 13 |
| 3 | 39 | 39 | 13 |
| 4 | 52 | 52 | 13 |
| 5 | 65 | 65 | 13 |
| 6 | 78 | 78 | 13 |
| 7 | 91 | 91 | 9 |
| 8 | 100 | ------ | ------- |

- At pass 8, since Current Index is equal to the number of records (100), log retrieval should stop; go to step 12 (see step 9 Notes).

12. No more records available, clean up.

13. Write 0x0000 -> [0xC34F, 1 reg], disengage the log.

**Send**: 0106 C34F 0000

**Command**:

Register Address: 0xC34F

# Registers: 1 (Write Single Register Command)

**Data**:

Log Number: 0 (ignore)

Enable: 0 (Disengage log)

Scope: 0 (ignore)

---

**Receive**: 0106C34F0000 (echo)

**NOTES**:

- This disengages the log, allowing it to be retrieved by other COM ports.
- The log will automatically disengage if no log retrieval action is taken for 5 minutes.

## B.5.5: Log Record Interpretation

The records of each log are composed of a 6 byte timestamp, and N data. The content of the data portion depends on the log.

**System Event Record:**

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Value | timestamp | | | | | | Group | Event | Mod | Chan | Param1 | Param2 | Param3 | Param4 |

**Size**: 14 bytes (20 bytes image).

**Data**: The System Event data is 8 bytes; each byte is an enumerated value.

- Group: Group of the event.
- Event: Event within a group.
- Modifier: Additional information about the event, such as number of sectors or log number.
- Channel: The port of the Shark® 200 meter that caused the event.

0 Firmware

1 COM 1 (IrDA)

| | |
|---|---|
| 2 | COM 2 (RS485) |
| 3 | COM 3 (Option Card 1) |
| 4 | COM 4 (Option Card 2) |
| 7 | User (Face Plate) |

Param 1-4: These are defined for each event (see table below).

**NOTE**: The System Log Record is 20 bytes, consisting of the Record Header (12 bytes) and Payload (8 bytes). The Timestamp (6 bytes) is in the header. Typically, software will retrieve only the timestamp and payload, yielding a 14-byte record. The table below shows all defined payloads.

| Group (Event group) | Event (Event within group) | Mod (Event modifier) | Channel (1-4 for COMs, 7 for USER, 0 for FW) | Parm1 | Parm2 | Parm3 | Parm4 | Comments |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | Startup |
| | 0 | 0 | 0 | FW version | | | | Meter Run Firmware Startup |
| | 1 | slot# | 0 | class ID | card status | 0xFF | 0xFF | Option Card Using Default Settings |
| | | | | | | | | |
| 1 | | | | | | | | Log Activity |
| | 1 | log# | 1-4 | 0xFF | 0xFF | 0xFF | 0xFF | Reset |
| | 2 | log# | 1-4 | 0xFF | 0xFF | 0xFF | 0xFF | Log Retrieval Begin |
| | 3 | log# | 0-4 | 0xFF | 0xFF | 0xFF | 0xFF | Log Retrieval End |
| | | | | | | | | |
| 2 | | | | | | | | Clock Activity |
| | 1 | 0 | 1-4 | 0xFF | 0xFF | 0xFF | 0xFF | Clock Changed |
| | 2 | 0 | 0 | 0xFF | 0xFF | 0xFF | 0xFF | Daylight Time On |
| | 3 | 0 | 0 | 0xFF | 0xFF | 0xFF | 0xFF | Daylight Time Off |
| | | | | | | | | |
| 3 | | | | | | | | System Resets |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 0 | 0-4, 7 | 0xFF | 0xFF | 0xFF | 0xFF | Max & Min Reset |
| | 2 | 0 | 0-4, 7 | 0xFF | 0xFF | 0xFF | 0xFF | Energy Reset |
| | 3 | slot# | 0-4 | 1 (inputs) or 2 (outputs) | 0xFF | 0xFF | 0xFF | Accumulators Reset |
| | | | | | | | | |
| 4 | | | | | | | | Settings Activity |
| | 1 | 0 | 1-4, 7 | 0xFF | 0xFF | 0xFF | 0xFF | Password Changed |
| | 2 | 0 | 1-4 | 0xFF | 0xFF | 0xFF | 0xFF | V-switch Changed |
| | 3 | 0 | 1-4, 7 | 0xFF | 0xFF | 0xFF | 0xFF | Programma-ble Settings Changed |
| | 4 | 0 | 1-4, 7 | 0xFF | 0xFF | 0xFF | 0xFF | Measurement Stopped |
| | | | | | | | | |
| 5 | | | | | | | | Boot Activity |
| | 1 | 0 | 1-4 | FW version | | | | Exit to Boot |
| | | | | | | | | |
| 6 | | | | | | | | Error Report-ing & Recovery |
| | 4 | log # | 0 | 0xFF | 0xFF | 0xFF | 0xFF | Log Babbling Detected |
| | 5 | log # | 0 | # records discarded | | time in seconds | | Babbling Log Periodic Summary |
| | 6 | log # | 0 | # records discarded | | time in seconds | | Log Babbling End Detected |
| | 7 | sector# | 0 | error count | | stimulus | 0xFF | Flash Sector Error |
| | 8 | 0 | 0 | 0xFF | 0xFF | 0xFF | 0xFF | Flash Error Counters Reset |
| | 9 | 0 | 0 | 0xFF | 0xFF | 0xFF | 0xFF | Flash Job Queue Over-flow |
| | | | | | | | | |
| 0x88 | | | | | | | | |
| | 1 | sector# | 0 | log # | 0xFF | 0xFF | 0xFF | acquire sector |
| | 2 | sector# | 0 | log # | 0xFF | 0xFF | 0xFF | release sector |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 3 | sector# | 0 | erase count | | | | erase sector |
| | 4 | log# | 0 | 0xFF | 0xFF | 0xFF | 0xFF | write log start record |

- log# values: 0 = system log, 1 = alarms log, 2-4 = historical logs 1-3, 5 = I/O change log
- sector# values: 0-63
- slot# values: 1-2

**NOTES**:

- Stimulus for a flash sector error indicates what the flash was doing when the error occurred: 1 = acquire sector, 2 = startup, 3 = empty sector, 4 = release sector, 5 = write data
- Flash error counters are reset to zero in the unlikely event that both copies in EEPROM are corrupted.
- A "babbling log" is one that is saving records faster than the meter can handle long term. Onset of babbling occurs when a log fills a flash sector in less than an hour. For as long as babbling persists, a summary of records discarded is logged every 60 minutes. Normal logging resumes when there have been no new append attempts for 30 seconds.
- Logging of diagnostic records may be suppressed via a bit in programmable settings.

**Alarm Record**:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Value | timestamp | | | | | | direction | limit# | Value% | |

**Size**: 10 bytes (16 bytes image)

**Data**: The Alarm record data is 4 bytes, and specifies which limit the event occurred on, and the direction of the event (going out of limit, or coming back into limit).

- Direction: The direction of the alarm event: whether this record indicates the limit going out, or coming back into limit.

  1 Going out of limit

  2 Coming back into limit

| Bit | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Value | type | 0 | 0 | 0 | 0 | Limit ID | | |

- Limit Type: Each limit (1-8) has both an above condition and a below condition. Limit Type indicates which of those the record represents.

  0 High Limit

  1 Low Limit

- Limit ID: The specific limit this record represents. A value in the range 0-7, Limit ID represents Limits 1-8. The specific details for this limit are stored in the programmable settings.

- Value: Depends on the Direction:

  - If the record is "Going out of limit," this is the value of the limit when the "Out" condition occurred.

  - If the record is "Coming back into limit," this is the "worst" value of the limit during the period of being "out": for High (above) limits, this is the highest value during the "out" period; for Low (below) limits, this is the lowest value during the "out" period.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Value | Identifier | | Above Setpoint | | Above Hyst. | | Below Setpoint | | Below Hyst. | |

**Interpretation of Alarm Data:**

To interpret the data from the alarm records, you need the limit data from the Programmable Settings [0x754B, 40 registers].

There are 8 limits, each with an Above Setpoint, and a Below Setpoint. Each setpoint also has a threshold (hysteresis), which is the value at which the limit returns "into"

limit after the setpoint has been exceeded. This prevents "babbling" limits, which can be caused by the limit value fluttering over the setpoint, causing it to go in and out of limit continuously.

- Identifier: The first modbus register of the value that is being watched by this limit. While any modbus register is valid, only values that can have a Full Scale will be used by the Shark® 200 meter.
- Above Setpoint: The percent of the Full Scale above which the value for this limit will be considered "out."
  - Valid in the range of -200.0% to +200.0%
  - Stored as an integer with 0.1 resolution. (Multiply % by 10 to get the integer, divide integer by 10 to get %. For example, 105.2% = 1052.)
- Above Hysteresis: The percent of the Full Scale below which the limit will return "into" limit, if it is out. If this value is above the Above Setpoint, this Above limit will be disabled.
  - Valid in the range of -200.0% to +200.0%.
  - Stored as an integer with 0.1 resolution. (Multiply % by 10 to get the integer, divide integer by 10 to get %. For example, 104.1% = 1041.)
- Below Setpoint: The percent of the Full Scale below which the value for this limit will be considered "out."
  - Valid in the range of -200.0% to +200.0%.
  - Stored as an integer with 0.1 resolution. (Multiply % by 10 to get the integer, divide integer by 10 to get %. For example, 93.5% = 935.)
- Below Hysteresis: The percent of the Full Scale above which the limit will return "into" limit, if it is out. If this value is below the Below Setpoint, this Below limit will be disabled.
  - Valid in the range of -200.0% to +200.0%.

- Stored as an integer with 0.1 resolution. (Multiply % by 10 to get the integer, divide integer by 10 to get %. For example, 94.9% = 949.)

**NOTES**:

- The Full Scale is the "nominal" value for each of the different types of readings. To compute the Full Scale, use the following formulas:

| | |
|---|---|
| Current | [CT Numerator] x [CT Multiplier] |
| Voltage | [PT Numerator] x [PT Multiplier] |
| Power 3-Phase (WYE) | [CT Numerator] x [CT Multiplier] x [PT Numerator] x [PT Multiplier] x 3 |
| Power 3-Phase (Delta) | [CT Numerator] x [CT Multiplier] x [PT Numerator] x [PT Multiplier] x 3 x sqrt(3) |
| Power Single Phase (WYE) | [CT Numerator] x [CT Multiplier] x [PT Numerator] x [PT Multiplier] |
| Power Single Phase (Delta) | [CT Numerator] x [CT Multiplier] x [PT Numerator] x [PT Multiplier] x sqrt(3) |
| Frequency (Calibrated at 60 Hz) | 60 |
| Frequency (Calibrated at 50 Hz) | 50 |
| Power Factor | 1.0 |
| THD, Harmonics | 100.0% |
| Angles | 180° |

- To interpret a limit alarm fully, you need both the start and end record (for duration).

- There are a few special conditions related to limits:

  - When the meter powers up, it detects limits from scratch. This means that multiple "out of limit" records can be in sequence with no "into limit" records. Cross- reference the System Events for Power Up events.
    - This also means that if a limit is "out," and it goes back in during the power off condition, no "into limit" record will be recorded.

- The "worst" value of the "into limit" record follows the above restrictions; it only represents the values since power up. Any values before the power up condition are lost.

**Historical Log Record:**

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | - | - | N |
|---|---|---|---|---|---|---|---|---|---|---|
| Value | timestamp | | | | | | values . . . | | | |

**Size**: 6+2 x N bytes (12+2 x N bytes), where N is the number of registers stored.

**Data**: The Historical Log Record data is 2 x N bytes, which contains snapshots of the values of the associated registers at the time the record was taken. Since the meter uses specific registers to log, with no knowledge of the data it contains, the Programmable Settings need to be used to interpret the data in the record. See Historical Logs Programmable Settings for details.

**I/O Change Record**:

I/O Change Log tables:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Value | Timestamp | | | | | | Card 1 Changes | Card 1 States | Card 2 Changes | Card 2 States |

Card Change Flags:

| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| Value | Out 4 Change | Out 3 Change | Out 2 Change | Out 1 Change | In 4 Change | In 3 Change | In 2 Change | In 1 Change |

Card Current States:

| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| Value | Out 4 State | Out 3 State | Out 2 State | Out 1 State | In 4 State | In 3 State | In 2 State | In 1 State |

**Size**: 10 bytes (16 bytes)

**Data**: The states of the relay and digital inputs at the time of capture for both Option cards 1 and 2. If the option card does not support I/O Change Records (no card or not a Digital Option Card), the value will be 0.

**NOTES**:

- An I/O Change log record will be taken for each Relay and Digital Input that has been configured in the Programmable Settings to record when its state changes.
- When any one configured Relay or Digital Input changes, the values of all Relays and Digital Inputs are recorded, even if they are not so configured.

## B.5.6: Examples

**Log Retrieval Section:**

```
send:  01 03 75 40 00 08 - Meter designation
recv:  01 03 10 4D 65 74 72 65 44 65 73 69 6E 67 5F 20 20 20 20 00 00

send:  :01 03 C7 57 00 10 - Historical Log 1 status block
recv:  :01 03 20 00 00 05 1E 00 00 05 1E 00 2C 00 00 06 08 17 51 08
        00 06 08 18 4E 39 00 00 00 00 00 00 00 00 00 00 00

send:  :01 03 79 17 00 40 - Historical Log 1 PS settings
recv:  :01 03 80 13 01 00 01 23 75 23 76 23 77 1F 3F 1F 40 1F 41 1F
        42 1F 43 1F 44 06 0B 06 0C 06 0D 06 0E 17 75 17 76 17 77 18
        67 18 68 18 69 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00

send:  :01 03 79 57 00 40 - ""
recv:  :01 03 80 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 62 62 62 34 34 34 44
        44 62 62 62 62 62 62 00 00 00 00 00 00

send:  :01 03 75 35 00 01 - Energy PS settings
recv:  :01 03 02 83 31 00 00

send:  :01 03 11 93 00 01 - Connected Port ID
recv:  :01 03 02 00 02 00 00

send:  :01 03 C7 57 00 10 - Historical Log 1 status block
recv:  :01 03 20 00 00 05 1E 00 00 05 1E 00 2C 00 00 06 08 17 51 08
        00 06 08 18 4E 39 00 00 00 00 00 00 00 00 00 00 00
```

```
send:  :01 03 C3 4F 00 01 - Log Retrieval header
recv:  :01 03 02 FF FF 00 00

send:  :01 10 C3 4F 00 04 08 02 80 05 01 00 00 00 00 - Engage the log
recv:  :01 10 C3 4F 00 04

send:  :01 03 C7 57 00 10 - Historical Log 1 status block
recv:  :01 03 20 00 00 05 1E 00 00 05 1E 00 2C 00 02 06 08 17 51 08
        00 06 08 18 4E 39 00 00 00 00 00 00 00 00 00 00 00

send:  :01 10 C3 51 00 02 04 00 00 00 00 - Set the retrieval index
recv:  :01 10 C3 51 00 02

send:  :01 03 C3 51 00 40 - Read first half of window
recv:  :01 03 80 00 00 00 00 06 08 17 51 08 00 00 19 00 2F 27 0F 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 03
        E8 00 01 00 05 00 00 00 00 00 00 06 08 17 51 09 00 00 19 00
        2F 27 0F 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 03 E8 00 01 00 04 00 00 00 00 00 00 06 08 17 51 0A
        00 00 19 00 2F 27 0F 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 03 E8 00 00 00 00

send:  :01 03 C3 91 00 30 - Read second half of window
recv:  :01 03 60 00 05 00 00 00 00 00 00 06 08 17 51 0B 00 00 19 00
        2F 27 0F 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 03 E8 00 01 00 04 00 00 00 00 00 00 06 08 17 51 0C
        00 00 19 00 2F 27 0F 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 03 E8 00 01 00 04 00 00 00 00 00 00 00
        00

send:  :01 03 C3 51 00 40 - Read first half of last window
recv:  :01 03 80 00 00 05 19 06 08 18 4E 35 00 00 19 00 2F 27 0F 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 03
        E8 00 01 00 04 00 00 00 00 00 00 06 08 18 4E 36 00 00 19 00
        2F 27 0F 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 03 E8 00 01 00 04 00 00 00 00 00 00 06 08 18 4E 37
        00 00 19 00 2F 27 0F 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 03 E8 00 00 00 00

send:  :01 03 C3 91 00 30 - Read second half of last window
recv:  :01 03 60 00 05 00 00 00 00 00 00 06 08 18 4E 38 00 00 19 00
        2F 27 0F 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 03 E8 00 01 00 04 00 00 00 00 00 00 06 08 18 4E 39
        00 00 19 00 2F 27 0F 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 03 E8 00 00 00 05 00 00 00 00 00 00 00
        00

send:  :01 06 C3 4F 00 00 - Disengage the log
```

**recv**: :01 06 C3 4F 00 00

**Sample Historical Log 1 Record:**

Historical Log 1 Record and Programmable Settings

```
13|01|00 01|23 75|23 76|23 77|1F 3F 1F 40|1F 41
1F 42|1F 43 1F 44|06 0B 06 0C|06 0D 06 0E|17 75|
17 76|17 77|18 67|18 68|18 69|00 00 . . . . . .
62 62 62 34 34 34 44 44 62 62 62 62 62 62 . . .
```

| These are the Item Values: | These are the Type and Size: | These are the Descriptions: |
|---|---|---|
| 13 | | - # registers |
| 01 | | - # sectors |
| 01 | | - interval |
| 23 75 | 6 2 | - (SINT 2 byte) Volts A THD Maximum |
| 23 76 | 6 2 | - (SINT 2 byte) Volts B THD Maximum |
| 23 77 | 6 2 | - (SINT 2 byte) Volts C THD Maximum |
| 1F 3F 1F 40 | 3 4 | - (Float 4 byte) Volts A Minimum |
| 1F 41 1F 42 | 3 4 | - (Float 4 byte) Volts B Minimum |
| 1F 43 1F 44 | 3 4 | - (Float 4 byte) Volts C Minimum |
| 06 0B 06 0C | 4 4 | - (Energy 4 byte) VARhr Negative Phase A |
| 06 0D 06 0E | 4 4 | - (Energy 4 byte) VARhr Negative Phase B |
| 17 75 | 6 2 | - (SINT 2 byte) Volts A 1st Harmonic Magnitude |
| 17 76 | 6 2 | - (SINT 2 byte) Volts A 2nd Harmonic Magnitude |
| 17 77 | 6 2 | - (SINT 2 byte) Volts A 3rd Harmonic Magnitude |
| 18 67 | 6 2 | - (SINT 2 byte) Ib 3rd Harmonic Magnitude |
| 18 68 | 6 2 | - (SINT 2 byte) Ib 4th Harmonic Magnitude |
| 18 69 | 6 2 | - (SINT 2 byte) Ib 5th Harmonic Magnitude |

**Sample Record**

```
06 08 17 51 08 00|00 19|00 2F|27 0F|00 00 00 00|00
00 00 00|00 00 00 00|00 00 00 00|00 00 00 00|03 E8|
00 01|00 05|00 00|00 00|00 00 . . .
```

```
11 08 17 51 08 00          - August 23, 2011 17:08:00
00 19                      - 2.5%
00 2F                      - 4.7%
27 0F                      - 999.9% (indicates the value isn't valid)
00 00 00 00                - 0
```

```
00 00 00 00                - 0
00 00 00 00                - 0
00 00 00 00                - 0
00 00 00 00                - 0
03 E8                      - 100.0% (Fundamental)
00 01                      - 0.1%
00 05                      - 0.5%
00 00                      - 0.0%
00 00                      - 0.0%
00 00                      - 0.0%
```

## B.6: Important Note Concerning the Shark ® 200 Meter's Modbus Map

In depicting Modbus Registers (Addresses), the Shark® 200 meter's Modbus map uses Holding Registers only.

### B.6.1: Hex Representation

The representation shown in the table below is used by developers of Modbus drivers and libraries, SEL 2020/2030 programmers and Firmware Developers. The Shark ® meter's Modbus map also uses this representation.

| Hex | Description |
|---|---|
| 0008 - 000F | Meter Serial Number |

### B.6.2: Decimal Representation

The Shark ® meter's Modbus map defines Holding Registers as (4X) registers. Many popular SCADA and HMI packages and their Modbus drivers have user interfaces that require users to enter these Registers starting at 40001. So instead of entering two separate values, one for register type and one for the actual register, they have been combined into one number.

The Shark ® 200 meter's Modbus map uses a shorthand version to depict the decimal fields, i.e., not all of the digits required for entry into the SCADA package UI are shown. For example:

You need to display the meter's serial number in your SCADA application. The Shark ® 200 meter's Modbus map shows the following information for meter serial number:

| Decimal | Description |
|---|---|
| 9 - 16 | Meter Serial Number |

In order to retrieve the meter's serial number, enter 40009 into the SCADA UI as the starting register, and 8 as the number of registers.

- In order to work with SCADA and Driver packages that use the 40001 to 49999 method for requesting holding registers, take 40000 and add the value of the register (Address) in the decimal column of the Modbus Map. Then enter the number (e.g., 4009) into the UI as the starting register.

- For SCADA and Driver packages that use the 400001 to 465536 method for requesting holding registers take 400000 and add the value of the register (Address) in the decimal column of the Modbus Map. Then enter the number (e.g., 400009) into the UI as the starting register. The drivers for these packages strip off the leading four and subtract 1 from the remaining value. This final value is used as the starting register or register to be included when building the actual modbus message.

## B.7: Modbus Register Map (MM-1 to MM-40)

The Shark® 200 meter's Modbus Register Map begins on the following page.

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | ***Fixed Data Section*** | | | | | |
| **Identification Block** | | | | | | **read-only** | |
| 0000 - 0007 | 1 - 8 | Meter Name | ASCII | 16 char | none | | 8 |
| 0008 - 000F | 9 - 16 | Meter Serial Number | ASCII | 16 char | none | | 8 |
| 0010 - 0010 | 17 - 17 | Meter Type | UINT16 | bit-mapped | ------st -----vvv | t = transducer model (1=yes, 0=no),<br>s= submeter model(1=yes,0=no),<br>vvv = V-switch:<br>V1 = standard 200,<br>V2 = V1 plus logging,<br>V3 = V2 plus THD,<br>V4 = V3 plus relays,<br>V5 = V4 plus waveform capture up to 64 samples/cycle and 3 Meg,<br>V6 = V4 plus waveform capture up to 512 samples/cycle and 4 Meg | 1 |
| 0011 - 0012 | 18 - 19 | Firmware Version | ASCII | 4 char | none | | 2 |
| 0013 - 0013 | 20 - 20 | Map Version | UINT16 | 0 to 65535 | none | | 1 |
| 0014 - 0014 | 21 - 21 | Meter Configuration | UINT16 | bit-mapped | -----ccc --ffffff | ccc = CT denominator (1 or 5),<br>ffffff = calibration frequency (50 or 60) | 1 |
| 0015 - 0015 | 22 - 22 | ASIC Version | UINT16 | 0-65535 | none | | 1 |
| 0016 - 0017 | 23 - 24 | Boot Firmware Version | ASCII | 4 char | none | | 2 |
| 0018 - 0018 | 25 - 25 | Option Slot 1 Usage | UINT16 | bit-mapped | same as register 10000 (0x270F) | | 1 |
| 0019 - 0019 | 26 - 26 | Option Slot 2 Usage | UINT16 | bit-mapped | same as register 11000 (0x2AF7) | | 1 |
| 001A - 001D | 27 - 30 | Meter Type Name | ASCII | 8 char | none | | 4 |
| 001E - 0026 | 31 - 39 | Reserved | | | | Reserved | 9 |
| 0027 - 002E | 40 - 47 | Reserved | | | | Reserved | 8 |
| 002F - 0115 | 48 - 278 | Reserved | | | | Reserved | 231 |
| 0116 - 0130 | 279 - 305 | Integer Readings Block occupies these registers, see below | | | | | |
| 0131 - 01F3 | 306 - 500 | Reserved | | | | Reserved | 194 |
| 01F4 - 0203 | 501 - 516 | Reserved | | | | Reserved | 16 |
| | | | | | | | |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | ***Meter Data Section (Note 2)*** | | | | | |
| **Readings Block ( Integer values)** | | | | | | **read-only** | |
| 0116 - 0116 | 279 - 279 | Volts A-N | UINT16 | 0 to 9999 | volts | | 1 |
| 0117 - 0117 | 280 - 280 | Volts B-N | UINT16 | 0 to 9999 | volts | | 1 |
| 0118 - 0118 | 281 - 281 | Volts C-N | UINT16 | 0 to 9999 | volts | | 1 |
| 0119 - 0119 | 282 - 282 | Volts A-B | UINT16 | 0 to 9999 | volts | | 1 |
| 011A - 011A | 283 - 283 | Volts B-C | UINT16 | 0 to 9999 | volts | | 1 |
| 011B - 011B | 284 - 284 | Volts C-A | UINT16 | 0 to 9999 | volts | | 1 |
| 011C - 011C | 285 - 285 | Amps A | UINT16 | 0 to 9999 | amps | | 1 |
| 011D - 011D | 286 - 286 | Amps B | UINT16 | 0 to 9999 | amps | | 1 |
| 011E - 011E | 287 - 287 | Amps C | UINT16 | 0 to 9999 | amps | | 1 |
| 011F - 011F | 288 - 288 | Neutral Current | UINT16 | -9999 to +9999 | amps | 1.Use the settings from Programmable settings for scale and decimal point location. (see User Settings Flags) | 1 |
| 0120 - 0120 | 289 - 289 | Watts, 3-Ph total | SINT16 | -9999 to +9999 | watts | | 1 |
| 0121 - 0121 | 290 - 290 | VARs, 3-Ph total | SINT16 | -9999 to +9999 | VARs | 2. Per phase power and PF have values | 1 |
| 0122 - 0122 | 291 - 291 | VAs, 3-Ph total | UINT16 | 0 to +9999 | VAs | only for WYE hookup and will be | 1 |
| 0123 - 0123 | 292 - 292 | Power Factor, 3-Ph total | SINT16 | -1000 to +1000 | none | zero for all other hookups. | 1 |
| 0124 - 0124 | 293 - 293 | Frequency | UINT16 | 0 to 9999 | Hz | | 1 |
| 0125 - 0125 | 294 - 294 | Watts, Phase A | SINT16 | -9999 M to +9999 | watts | 3. If the reading is 10000 that means that the value is out | 1 |
| 0126 - 0126 | 295 - 295 | Watts, Phase B | SINT16 | -9999 M to +9999 | watts | of range. Please adjust the programmable settings in | 1 |
| 0127 - 0127 | 296 - 296 | Watts, Phase C | SINT16 | -9999 M to +9999 | watts | that case. The display will also show '----' in case of over | 1 |
| 0128 - 0128 | 297 - 297 | VARs, Phase A | SINT16 | -9999 M to +9999 M | VARs | range. | 1 |
| 0129 - 0129 | 298 - 298 | VARs, Phase B | SINT16 | -9999 M to +9999 M | VARs | | 1 |
| 012A - 012A | 299 - 299 | VARs, Phase C | SINT16 | -9999 M to +9999 M | VARs | | 1 |
| 012B - 012B | 300 - 300 | VAs, Phase A | UINT16 | 0 to +9999 | VAs | | 1 |
| 012C - 012C | 301 - 301 | VAs, Phase B | UINT16 | 0 to +9999 | VAs | | 1 |
| 012D - 012D | 302 - 302 | VAs, Phase C | UINT16 | 0 to +9999 | VAs | | 1 |
| 012E - 012E | 303 - 303 | Power Factor, Phase A | SINT16 | -1000 to +1000 | none | | 1 |
| 012F - 012F | 304 - 304 | Power Factor, Phase B | SINT16 | -1000 to +1000 | none | | 1 |
| 0130 - 0130 | 305 - 305 | Power Factor, Phase C | SINT16 | -1000 to +1000 | none | | 1 |
| | | | | | | Block Size: | 27 |
| **Primary Readings Block** | | | | | | **read-only** | |
| 03E7 - 03E8 | 1000 - 1001 | Volts A-N | FLOAT | 0 to 9999 M | volts | | 2 |
| 03E9 - 03EA | 1002 - 1003 | Volts B-N | FLOAT | 0 to 9999 M | volts | | 2 |
| 03EB - 03EC | 1004 - 1005 | Volts C-N | FLOAT | 0 to 9999 M | volts | | 2 |
| 03ED - 03EE | 1006 - 1007 | Volts A-B | FLOAT | 0 to 9999 M | volts | | 2 |
| 03EF - 03F0 | 1008 - 1009 | Volts B-C | FLOAT | 0 to 9999 M | volts | | 2 |
| 03F1 - 03F2 | 1010 - 1011 | Volts C-A | FLOAT | 0 to 9999 M | volts | | 2 |
| 03F3 - 03F4 | 1012 - 1013 | Amps A | FLOAT | 0 to 9999 M | amps | | 2 |
| 03F5 - 03F6 | 1014 - 1015 | Amps B | FLOAT | 0 to 9999 M | amps | | 2 |
| 03F7 - 03F8 | 1016 - 1017 | Amps C | FLOAT | 0 to 9999 M | amps | | 2 |
| 03F9 - 03FA | 1018 - 1019 | Watts, 3-Ph total | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 03FB - 03FC | 1020 - 1021 | VARs, 3-Ph total | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 03FD - 03FE | 1022 - 1023 | VAs, 3-Ph total | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 03FF - 0400 | 1024 - 1025 | Power Factor, 3-Ph total | FLOAT | -1.00 to +1.00 | none | | 2 |
| 0401 - 0402 | 1026 - 1027 | Frequency | FLOAT | 0 to 65.00 | Hz | | 2 |
| 0403 - 0404 | 1028 - 1029 | Neutral Current | FLOAT | 0 to 9999 M | amps | | 2 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| 0405 - 0406 | 1030 - 1031 | Watts, Phase A | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 0407 - 0408 | 1032 - 1033 | Watts, Phase B | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 0409 - 040A | 1034 - 1035 | Watts, Phase C | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 040B - 040C | 1036 - 1037 | VARs, Phase A | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 040D - 040E | 1038 - 1039 | VARs, Phase B | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 040F - 0410 | 1040 - 1041 | VARs, Phase C | FLOAT | -9999 M to +9999 M | VARs | Per phase power and PF have values only for WYE hookup and will be zero for all other hookups. | 2 |
| 0411 - 0412 | 1042 - 1043 | VAs, Phase A | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 0413 - 0414 | 1044 - 1045 | VAs, Phase B | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 0415 - 0416 | 1046 - 1047 | VAs, Phase C | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 0417 - 0418 | 1048 - 1049 | Power Factor, Phase A | FLOAT | -1.00 to +1.00 | none | | 2 |
| 0419 - 041A | 1050 - 1051 | Power Factor, Phase B | FLOAT | -1.00 to +1.00 | none | | 2 |
| 041B - 041C | 1052 - 1053 | Power Factor, Phase C | FLOAT | -1.00 to +1.00 | none | | 2 |
| 041D - 041E | 1054 - 1055 | Symmetrical Component Magnitude, 0 Seq | FLOAT | 0 to 9999 M | volts | | 2 |
| 041F - 0420 | 1056 - 1057 | Symmetrical Component Magnitude, + Seq | FLOAT | 0 to 9999 M | volts | | 2 |
| 0421 - 0422 | 1058 - 1059 | Symmetrical Component Magnitude, - Seq | FLOAT | 0 to 9999 M | volts | Voltage unbalance per IEC6100-4.30 | 2 |
| 0423 - 0423 | 1060 - 1060 | Symmetrical Component Phase, 0 Seq | SINT16 | -1800 to +1800 | 0.1 degree | | 1 |
| 0424 - 0424 | 1061 - 1061 | Symmetrical Component Phase, + Seq | SINT16 | -1800 to +1800 | 0.1 degree | Values apply only to WYE hookup and will be zero for all other hookups. | 1 |
| 0425 - 0425 | 1062 - 1062 | Symmetrical Component Phase, - Seq | SINT16 | -1800 to +1800 | 0.1 degree | | 1 |
| 0426 - 0426 | 1063 - 1063 | Unbalance, 0 sequence component | UINT16 | 0 to 65535 | 0.01% | | 1 |
| 0427 - 0427 | 1064 - 1064 | Unbalance, -sequence component | UINT16 | 0 to 65535 | 0.01% | | 1 |
| 0428 - 0428 | 1065 - 1065 | Current Unbalance | UINT16 | 0 to 20000 | 0.01% | | 1 |
| | | | | | | Block Size: | 66 |
| **Primary Energy Block** | | | | | | **read-only** | |
| 05DB - 05DC | 1500 - 1501 | W-hours, Received | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | * Wh received & delivered always have opposite signs | 2 |
| 05DD - 05DE | 1502 - 1503 | W-hours, Delivered | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | * Wh received is positive for "view as load", delivered is positive for "view as generator" | 2 |
| 05DF - 05E0 | 1504 - 1505 | W-hours, Net | SINT32 | -99999999 to 99999999 | Wh per energy format | * 5 to 8 digits | 2 |
| 05E1 - 05E2 | 1506 - 1507 | W-hours, Total | SINT32 | 0 to 99999999 | Wh per energy format | | 2 |
| 05E3 - 05E4 | 1508 - 1509 | VAR-hours, Positive | SINT32 | 0 to 99999999 | VARh per energy format | * decimal point implied, per energy format | 2 |
| 05E5 - 05E6 | 1510 - 1511 | VAR-hours, Negative | SINT32 | 0 to -99999999 | VARh per energy format | | 2 |
| 05E7 - 05E8 | 1512 - 1513 | VAR-hours, Net | SINT32 | -99999999 to 99999999 | VARh per energy format | * resolution of digit before decimal point = units, kilo, or mega, per energy format | 2 |
| 05E9 - 05EA | 1514 - 1515 | VAR-hours, Total | SINT32 | 0 to 99999999 | VARh per energy format | * see note 10 | 2 |
| 05EB - 05EC | 1516 - 1517 | VA-hours, Total | SINT32 | 0 to 99999999 | VAh per energy format | | 2 |
| 05ED - 05EE | 1518 - 1519 | W-hours, Received, Phase A | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | | 2 |
| 05EF - 05F0 | 1520 - 1521 | W-hours, Received, Phase B | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | | 2 |
| 05F1 - 05F2 | 1522 - 1523 | W-hours, Received, Phase C | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | | 2 |
| 05F3 - 05F4 | 1524 - 1525 | W-hours, Delivered, Phase A | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | | 2 |
| 05F5 - 05F6 | 1526 - 1527 | W-hours, Delivered, Phase B | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | | 2 |
| 05F7 - 05F8 | 1528 - 1529 | W-hours, Delivered, Phase C | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | | 2 |
| 05F9 - 05FA | 1530 - 1531 | W-hours, Net, Phase A | SINT32 | -99999999 to 99999999 | Wh per energy format | | 2 |
| 05FB - 05FC | 1532 - 1533 | W-hours, Net, Phase B | SINT32 | -99999999 to 99999999 | Wh per energy format | | 2 |
| 05FD - 05FE | 1534 - 1535 | W-hours, Net, Phase C | SINT32 | -99999999 to 99999999 | Wh per energy format | | 2 |
| 05FF - 0600 | 1536 - 1537 | W-hours, Total, Phase A | SINT32 | 0 to 99999999 | Wh per energy format | | 2 |
| 0601 - 0602 | 1538 - 1539 | W-hours, Total, Phase B | SINT32 | 0 to 99999999 | Wh per energy format | | 2 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| 0603 - 0604 | 1540 - 1541 | W-hours, Total, Phase C | SINT32 | 0 to 99999999 | Wh per energy format | | 2 |
| 0605 - 0606 | 1542 - 1543 | VAR-hours, Positive, Phase A | SINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 0607 - 0608 | 1544 - 1545 | VAR-hours, Positive, Phase B | SINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 0609 - 060A | 1546 - 1547 | VAR-hours, Positive, Phase C | SINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 060B - 060C | 1548 - 1549 | VAR-hours, Negative, Phase A | SINT32 | 0 to -99999999 | VARh per energy format | | 2 |
| 060D - 060E | 1550 - 1551 | VAR-hours, Negative, Phase B | SINT32 | 0 to -99999999 | VARh per energy format | | 2 |
| 060F - 0610 | 1552 - 1553 | VAR-hours, Negative, Phase C | SINT32 | 0 to -99999999 | VARh per energy format | | 2 |
| 0611 - 0612 | 1554 - 1555 | VAR-hours, Net, Phase A | SINT32 | -99999999 to 99999999 | VARh per energy format | | 2 |
| 0613 - 0614 | 1556 - 1557 | VAR-hours, Net, Phase B | SINT32 | -99999999 to 99999999 | VARh per energy format | | 2 |
| 0615 - 0616 | 1558 - 1559 | VAR-hours, Net, Phase C | SINT32 | -99999999 to 99999999 | VARh per energy format | | 2 |
| 0617 - 0618 | 1560 - 1561 | VAR-hours, Total, Phase A | SINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 0619 - 061A | 1562 - 1563 | VAR-hours, Total, Phase B | SINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 061B - 061C | 1564 - 1565 | VAR-hours, Total, Phase C | SINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 061D - 061E | 1566 - 1567 | VA-hours, Phase A | SINT32 | 0 to 99999999 | VAh per energy format | | 2 |
| 061F - 0620 | 1568 - 1569 | VA-hours, Phase B | SINT32 | 0 to 99999999 | VAh per energy format | | 2 |
| 0621 - 0622 | 1570 - 1571 | VA-hours, Phase C | SINT32 | 0 to 99999999 | VAh per energy format | | 2 |
| 0623 - 0624 | 1572 - 1573 | W-hours, Received, rollover count | UINT32 | 0 to 4,294,967,294 | | These registers count the number of times their corresponding energy accumulators have wrapped from ±max to 0. They are reset when energy is reset. | 2 |
| 0625 - 0626 | 1574 - 1575 | W-hours, Delivered, rollover count | UINT32 | 0 to 4,294,967,294 | | | 2 |
| 0627 - 0628 | 1576 - 1577 | VAR-hours, Positive, rollover count | UINT32 | 0 to 4,294,967,294 | | | 2 |
| 0629 - 062A | 1578 - 1579 | VAR-hours, Negative, rollover count | UINT32 | 0 to 4,294,967,294 | | | 2 |
| 062B - 062C | 1580 - 1581 | VA-hours, rollover count | UINT32 | 0 to 4,294,967,294 | | | 2 |
| 062D - 062E | 1582 - 1583 | W-hours in the Interval, Received | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | * Wh received & delivered always have opposite signs | 2 |
| 062F - 0630 | 1584 - 1585 | W-hours in the Interval, Delivered | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | * Wh received is positive for "view as load" , delivered is positive for "view as generator" | 2 |
| 0631 - 0632 | 1586 - 1587 | VAR-hours in the Interval, Positive | SINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 0633 - 0634 | 1588 - 1589 | VAR-hours in the Interval, Negative | SINT32 | 0 to -99999999 | VARh per energy format | * 5 to 8 digits | 2 |
| 0635 - 0636 | 1590 - 1591 | VA-hours in the Interval, Total | SINT32 | 0 to 99999999 | VAh per energy format | | 2 |
| 0637 - 0638 | 1592 - 1593 | W-hours in the Interval, Received, Phase A | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | * decimal point implied, per energy format | 2 |
| 0639 - 063A | 1594 - 1595 | W-hours in the Interval, Received, Phase B | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | * resolution of digit before decimal point = units, kilo, or mega, per energy format | 2 |
| 063B - 063C | 1596 - 1597 | W-hours in the Interval, Received, Phase C | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | * see note 10 | 2 |
| 063D - 063E | 1598 - 1599 | W-hours in the Interval, Delivered, Phase A | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | | 2 |
| 063F - 0640 | 1600 - 1601 | W-hours in the Interval, Delivered, Phase B | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | | 2 |
| 0641 - 0642 | 1602 - 1603 | W-hours in the Interval, Delivered, Phase C | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | | 2 |
| 0643 - 0644 | 1604 - 1605 | VAR-hours in the Interval, Positive, Phase A | SINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 0645 - 0646 | 1606 - 1607 | VAR-hours in the Interval, Positive, Phase B | SINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 0647 - 0648 | 1608 - 1609 | VAR-hours in the Interval, Positive, Phase C | SINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 0649 - 064A | 1610 - 1611 | VAR-hours in the Interval, Negative, Phase A | SINT32 | 0 to -99999999 | VARh per energy format | | 2 |
| 064B - 064C | 1612 - 1613 | VAR-hours in the Interval, Negative, Phase B | SINT32 | 0 to -99999999 | VARh per energy format | | 2 |
| 063D - 064E | 1614 - 1615 | VAR-hours in the Interval, Negative, Phase C | SINT32 | 0 to -99999999 | VARh per energy format | | 2 |
| 064F - 0650 | 1616 - 1617 | VA-hours in the Interval, Phase A | SINT32 | 0 to 99999999 | VAh per energy format | | 2 |
| 0651 - 0652 | 1618 - 1619 | VA-hours in the Interval, Phase B | SINT32 | 0 to 99999999 | VAh per energy format | | 2 |
| 0653 - 0654 | 1620 - 1621 | VA-hours in the Interval, Phase C | SINT32 | 0 to 99999999 | VAh per energy format | | 2 |
| | | | | | | Block Size: | 122 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| **Primary Demand Block** | | | | | | **read-only** | |
| 07CC - 07CE | 1997 - 1999 | Demand Interval End Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | Ex. Timestamp hh:mm:ss is 03:15:00 and interval size is 15 minutes. Demand interval was 3:00:00 to 3:15:00. Note: Timestamp is zero until the end of the first interval after meter startup. | 3 |
| 07CF - 07D0 | 2000 - 2001 | Amps A, Average | FLOAT | 0 to 9999 M | amps | | 2 |
| 07D1 - 07D2 | 2002 - 2003 | Amps B, Average | FLOAT | 0 to 9999 M | amps | | 2 |
| 07D3 - 07D4 | 2004 - 2005 | Amps C, Average | FLOAT | 0 to 9999 M | amps | | 2 |
| 07D5 - 07D6 | 2006 - 2007 | Positive Watts, 3-Ph, Average | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 07D7 - 07D8 | 2008 - 2009 | Positive VARs, 3-Ph, Average | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 07D9 - 07DA | 2010 - 2011 | Negative Watts, 3-Ph, Average | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 07DB - 07DC | 2012 - 2013 | Negative VARs, 3-Ph, Average | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 07DD - 07DE | 2014 - 2015 | VAs, 3-Ph, Average | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 07DF - 07E0 | 2016 - 2017 | Positive PF, 3-Ph, Average | FLOAT | -1.00 to +1.00 | none | | 2 |
| 07E1 - 07E2 | 2018 - 2019 | Negative PF, 3-PF, Average | FLOAT | -1.00 to +1.00 | none | | 2 |
| 07E3 - 07E4 | 2020 - 2021 | Neutral Current, Average | FLOAT | 0 to 9999 M | amps | | 2 |
| 07E5 - 07E6 | 2022 - 2023 | Positive Watts, Phase A, Average | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 07E7 - 07E8 | 2024 - 2025 | Positive Watts, Phase B, Average | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 07E9 - 07EA | 2026 - 2027 | Positive Watts, Phase C, Average | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 07EB - 07EC | 2028 - 2029 | Positive VARs, Phase A, Average | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 07ED - 07EE | 2030 - 2031 | Positive VARs, Phase B, Average | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 07EF - 07F0 | 2032 - 2033 | Positive VARs, Phase C, Average | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 07F1 - 07F2 | 2034 - 2035 | Negative Watts, Phase A, Average | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 07F3 - 07F4 | 2036 - 2037 | Negative Watts, Phase B, Average | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 07F5 - 07F6 | 2038 - 2039 | Negative Watts, Phase C, Average | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 07F7 - 07F8 | 2040 - 2041 | Negative VARs, Phase A, Average | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 07F9 - 07FA | 2042 - 2043 | Negative VARs, Phase B, Average | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 07FB - 07FC | 2044 - 2045 | Negative VARs, Phase C, Average | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 07FD - 07FE | 2046 - 2047 | VAs, Phase A, Average | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 07FF - 0800 | 2048 - 2049 | VAs, Phase B, Average | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 0801 - 0802 | 2050 - 2051 | VAs, Phase C, Average | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 0803 - 0804 | 2052 - 2053 | Positive PF, Phase A, Average | FLOAT | -1.00 to +1.00 | none | | 2 |
| 0805 - 0806 | 2054 - 2055 | Positive PF, Phase B, Average | FLOAT | -1.00 to +1.00 | none | | 2 |
| 0807 - 0808 | 2056 - 2057 | Positive PF, Phase C, Average | FLOAT | -1.00 to +1.00 | none | | 2 |
| 0809 - 080A | 2058 - 2059 | Negative PF, Phase A, Average | FLOAT | -1.00 to +1.00 | none | | 2 |
| 080B - 080C | 2060 - 2061 | Negative PF, Phase B, Average | FLOAT | -1.00 to +1.00 | none | | 2 |
| 080D - 080E | 2062 - 2063 | Negative PF, Phase C, Average | FLOAT | -1.00 to +1.00 | none | | 2 |
| | | | | | | Block Size: | 64 |
| **Uncompensated Readings Block** | | | | | | **read-only** | |
| 0BB7 - 0BB8 | 3000 - 3001 | Watts, 3-Ph total | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 0BB9 - 0BBA | 3002 - 3003 | VARs, 3-Ph total | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 0BBB - 0BBC | 3004 - 3005 | VAs, 3-Ph total | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 0BBD - 0BBE | 3006 - 3007 | Power Factor, 3-Ph total | FLOAT | -1.00 to +1.00 | none | | 2 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| 0BBF - 0BC0 | 3008 - 3009 | Watts, Phase A | FLOAT | -9999 M to +9999 M | watts | Per phase power and PF have values only for WYE hookup and will be zero for all other hookups. | 2 |
| 0BC1 - 0BC2 | 3010 - 3011 | Watts, Phase B | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 0BC3 - 0BC4 | 3012 - 3013 | Watts, Phase C | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 0BC5 - 0BC6 | 3014 - 3015 | VARs, Phase A | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| OBC7 - 0BC8 | 3016 - 3017 | VARs, Phase B | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 0BC9 - 0BCA | 3018 - 3019 | VARs, Phase C | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 0BCB - 0BCC | 3020 - 3021 | VAs, Phase A | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 0BCD - 0BCE | 3022 - 3023 | VAs, Phase B | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 0BCF - 0BD0 | 3024 - 3025 | VAs, Phase C | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 0BD1 - 0BD2 | 3026 - 3027 | Power Factor, Phase A | FLOAT | -1.00 to +1.00 | none | | 2 |
| 0BD3 - 0BD4 | 3028 - 3029 | Power Factor, Phase B | FLOAT | -1.00 to +1.00 | none | | 2 |
| 0BD5 - 0BD6 | 3030 - 3031 | Power Factor, Phase C | FLOAT | -1.00 to +1.00 | none | | 2 |
| 0BD7 - 0BD8 | 3032 - 3033 | W-hours, Received | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | * Wh received & delivered always have opposite signs | 2 |
| 0BD9 - 0BDA | 3034 - 3035 | W-hours, Delivered | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | * Wh received is positive for "view as load", delivered is positive for "view as generator" | 2 |
| 0BDB - 0BDC | 3036 - 3037 | W-hours, Net | SINT32 | -99999999 to 99999999 | Wh per energy format | * 5 to 8 digits | 2 |
| 0BDD - 0BDE | 3038 - 3039 | W-hours, Total | SINT32 | 0 to 99999999 | Wh per energy format | | 2 |
| 0BDF - 0BE0 | 3040 - 3041 | VAR-hours, Positive | SINT32 | 0 to 99999999 | VARh per energy format | * decimal point implied, per energy format | 2 |
| 0BE1 - 0BE2 | 3042 - 3043 | VAR-hours, Negative | SINT32 | 0 to -99999999 | VARh per energy format | | 2 |
| 0BE3 - 0BE4 | 3044 - 3045 | VAR-hours, Net | SINT32 | -99999999 to 99999999 | VARh per energy format | * resolution of digit before decimal point = units, kilo, or mega, per energy format | 2 |
| 0BE5 - 0BE6 | 3046 - 3047 | VAR-hours, Total | SINT32 | 0 to 99999999 | VARh per energy format | * see note 10 | 2 |
| 0BE7 - 0BE8 | 3048 - 3049 | VA-hours, Total | SINT32 | 0 to 99999999 | VAh per energy format | | 2 |
| 0BE9 - 0BEA | 3050 - 3051 | W-hours, Received, Phase A | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | | 2 |
| 0BEB - 0BEC | 3052 - 3053 | W-hours, Received, Phase B | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | | 2 |
| 0BED - 0BEE | 3054 - 3055 | W-hours, Received, Phase C | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | | 2 |
| 0BEF - 0BF0 | 3056 - 3057 | W-hours, Delivered, Phase A | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | | 2 |
| 0BF1 - 0BF2 | 3058 - 3059 | W-hours, Delivered, Phase B | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | | 2 |
| 0BF3 - 0BF4 | 3060 - 3061 | W-hours, Delivered, Phase C | SINT32 | 0 to 99999999 or 0 to -99999999 | Wh per energy format | | 2 |
| 0BF5 - 0BF6 | 3062 - 3063 | W-hours, Net, Phase A | SINT32 | -99999999 to 99999999 | Wh per energy format | | 2 |
| 0BF7 - 0BF8 | 3064 - 3065 | W-hours, Net, Phase B | SINT32 | -99999999 to 99999999 | Wh per energy format | | 2 |
| 0BF9 - 0BFA | 3066 - 3067 | W-hours, Net, Phase C | SINT32 | -99999999 to 99999999 | Wh per energy format | | 2 |
| 0BFB - 0BFC | 3068 - 3069 | W-hours, Total, Phase A | SINT32 | 0 to 99999999 | Wh per energy format | | 2 |
| 0BFD - 0BFE | 3070 - 3071 | W-hours, Total, Phase B | SINT32 | 0 to 99999999 | Wh per energy format | | 2 |
| 0BFF - 0C00 | 3072 - 3073 | W-hours, Total, Phase C | SINT32 | 0 to 99999999 | Wh per energy format | | 2 |
| 0C01 - 0C02 | 3074 - 3075 | VAR-hours, Positive, Phase A | SINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 0C03 - 0C04 | 3076 - 3077 | VAR-hours, Positive, Phase B | SINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 0C05 - 0C06 | 3078 - 3079 | VAR-hours, Positive, Phase C | SINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 0C07 - 0C08 | 3080 - 3081 | VAR-hours, Negative, Phase A | SINT32 | 0 to -99999999 | VARh per energy format | | 2 |
| 0C09 - 0C0A | 3082 - 3083 | VAR-hours, Negative, Phase B | SINT32 | 0 to -99999999 | VARh per energy format | | 2 |
| 0C0B - 0C0C | 3084 - 3085 | VAR-hours, Negative, Phase C | SINT32 | 0 to -99999999 | VARh per energy format | | 2 |
| 0C0D - 0C0E | 3086 - 3087 | VAR-hours, Net, Phase A | SINT32 | -99999999 to 99999999 | VARh per energy format | | 2 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| 0C0F - 0C10 | 3088 - 3089 | VAR-hours, Net, Phase B | SINT32 | -99999999 to 99999999 | VARh per energy format | | 2 |
| 0C11 - 0C12 | 3090 - 3091 | VAR-hours, Net, Phase C | SINT32 | -99999999 to 99999999 | VARh per energy format | | 2 |
| 0C13 - 0C14 | 3092 - 3093 | VAR-hours, Total, Phase A | SINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 0C15 - 0C16 | 3094 - 3095 | VAR-hours, Total, Phase B | SINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 0C17 - 0C18 | 3096 - 3097 | VAR-hours, Total, Phase C | SINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 0C19 - 0C1A | 3098 - 3099 | VA-hours, Phase A | SINT32 | 0 to 99999999 | VAh per energy format | | 2 |
| 0C1B - 0C1C | 3100 - 3101 | VA-hours, Phase B | SINT32 | 0 to 99999999 | VAh per energy format | | 2 |
| 0C1D - 0C1E | 3102 - 3103 | VA-hours, Phase C | SINT32 | 0 to 99999999 | VAh per energy format | | 2 |
| | | | | | | Block Size: | 104 |
| **Phase Angle Block** | | | | | | **read-only** | |
| 1003 - 1003 | 4100 - 4100 | Phase A Current | SINT16 | -1800 to +1800 | 0.1 degree | | 1 |
| 1004 - 1004 | 4101 - 4101 | Phase B Current | SINT16 | -1800 to +1800 | 0.1 degree | | 1 |
| 1005 - 1005 | 4102 - 4102 | Phase C Current | SINT16 | -1800 to +1800 | 0.1 degree | | 1 |
| 1006 - 1006 | 4103 - 4103 | Angle, Volts A-B | SINT16 | -1800 to +1800 | 0.1 degree | | 1 |
| 1007 - 1007 | 4104 - 4104 | Angle, Volts B-C | SINT16 | -1800 to +1800 | 0.1 degree | | 1 |
| 1008 - 1008 | 4105 - 4105 | Angle, Volts C-A | SINT16 | -1800 to +1800 | 0.1 degree | | 1 |
| | | | | | | Block Size: | 6 |
| **Status Block** | | | | | | **read-only** | |
| 1193 - 1193 | 4500 - 4500 | Port ID | UINT16 | 1 to 4 | none | Identifies which Shark COM port a master is connected to; 1 for COM1, 2 for COM2, etc. | 1 |
| 1194 - 1194 | 4501 - 4501 | Meter Status | UINT16 | bit-mapped | mmmpch-- tffeeccc | mmm = measurement state (0=off, 1=running normally, 2=limp mode, 3=warmup, 6&7=boot, others unused) See note 16.<br>pch = NVMEM block OK flags (p=profile, c=calibration, h=header), flag is 1 if OK<br>t - CT PT compensation status. (0=Disabled,1=Enabled)<br>ff = flash state (0=initializing, 1=logging disabled by Vswitch, 3=logging)<br>ee = edit state (0=startup, 1=normal, 2=privileged command session, 3=profile update mode)<br>ccc = port enabled for edit(0=none, 1-4=COM1-COM4, 7=front panel) | 1 |
| 1195 - 1195 | 4502 - 4502 | Limits Status | UINT16 | bit-mapped | 87654321 87654321 | high byte is setpt 1, 0=in, 1=out<br>low byte is setpt 2, 0=in, 1=out<br>see notes 11, 12, 17 | 1 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| 1196 - 1197 | 4503 - 4504 | Time Since Reset | UINT32 | 0 to 4294967294 | 4 msec | wraps around after max count | 2 |
| 1198 - 119A | 4505 - 4507 | Meter On Time | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 119B - 119D | 4508 - 4510 | Current Date and Time | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 119E - 119E | 4511 - 4511 | Clock Sync Status | UINT16 | bit-mapped | mmmp pppe 0000 000s | mmmp pppe = configuration per programmable settings (see register 30011, 0x753A)<br>s = status: 1=working properly, 0=not working | 1 |
| 119F - 119F | 4512 - 4512 | Current Day of Week | UINT16 | 1 to 7 | 1 day | 1=Sun, 2=Mon, etc. | 1 |
| | | | | | | Block Size: | 13 |
| **THD Block (Note 13)** | | | | | | **read-only** | |
| 176F - 176F | 6000 - 6000 | Volts A-N, %THD | UINT16 | 0 to 10000 | 0.01% | | 1 |
| 1770 - 1770 | 6001 - 6001 | Volts B-N, %THD | UINT16 | 0 to 10000 | 0.01% | | 1 |
| 1771 - 1771 | 6002 - 6002 | Volts C-N, %THD | UINT16 | 0 to 10000 | 0.01% | | 1 |
| 1772 - 1772 | 6003 - 6003 | Amps A, %THD | UINT16 | 0 to 10000 | 0.01% | | 1 |
| 1773 - 1773 | 6004 - 6004 | Amps B, %THD | UINT16 | 0 to 10000 | 0.01% | | 1 |
| 1774 - 1774 | 6005 - 6005 | Amps C, %THD | UINT16 | 0 to 10000 | 0.01% | | 1 |
| 1775 - 179C | 6006 - 6045 | Phase A Voltage harmonic magnitudes | UINT16 | 0 to 10000 | 0.01% | In each group of 40 registers, the first register represents the fundamental frequency or first harmonic, the second represents the second harmonic, and so on up to the 40th register which represents the 40th harmonic.<br><br>Harmonic magnitudes are given as % of the fundamental magnitude. Thus the first register in each group of 40 will typically be 9999. A reading of 10000 indicates invalid. | 40 |
| 179D - 17C4 | 6046 - 6085 | Phase A Voltage harmonic phases | SINT16 | -1800 to +1800 | 0.1 degree | | 40 |
| 17C5 - 17EC | 6086 - 6125 | Phase A Current harmonic magnitudes | UINT16 | 0 to 10000 | 0.01% | | 40 |
| 17ED - 1814 | 6126 - 6165 | Phase A Current harmonic phases | SINT16 | -1800 to +1800 | 0.1 degree | | 40 |
| 1815 - 183C | 6166 - 6205 | Phase B Voltage harmonic magnitudes | UINT16 | 0 to 10000 | 0.01% | | 40 |
| 183D - 1864 | 6206 - 6245 | Phase B Voltage harmonic phases | SINT16 | -1800 to +1800 | 0.1 degree | | 40 |
| 1865 - 188C | 6246 - 6285 | Phase B Current harmonic magnitudes | UINT16 | 0 to 10000 | 0.01% | | 40 |
| 188D - 18B4 | 6286 - 6325 | Phase B Current harmonic phases | SINT16 | -1800 to +1800 | 0.1 degree | | 40 |
| 18B5 - 18DC | 6326 - 6365 | Phase C Voltage harmonic magnitudes | UINT16 | 0 to 10000 | 0.01% | | 40 |
| 18DD - 1904 | 6366 - 6405 | Phase C Voltage harmonic phases | SINT16 | -1800 to +1800 | 0.1 degree | | 40 |
| 1905 - 192C | 6406 - 6445 | Phase C Current harmonic magnitudes | UINT16 | 0 to 10000 | 0.01% | | 40 |
| 192D - 1954 | 6446 - 6485 | Phase C Current harmonic phases | SINT16 | -1800 to +1800 | 0.1 degree | | 40 |
| 1955 - 1955 | 6486 - 6486 | Wave Scope scale factor for channel Va | UINT16 | 0 to 32767 | | Convert individual samples to volts or amps:<br><br>V or A = (sample * scale factor) / 1,000,000<br><br>Samples update in conjunction with THD and harmonics; samples not available (all zeroes) if THD not available. | 1 |
| 1956 - 1956 | 6487 - 6487 | Wave Scope scale factors for channel Ib | UINT16 | 0 to 32767 | | | 1 |
| 1957 - 1958 | 6488 - 6489 | Wave Scope scale factors for channels Vb and Ib | UINT16 | 0 to 32767 | | | 2 |
| 1959 - 195A | 6490 - 6491 | Wave Scope scale factors for channels Vc and Ic | UINT16 | 0 to 32767 | | | 2 |
| 195B - 199A | 6492 - 6555 | Wave Scope samples for channel Va | SINT16 | -32768 to +32767 | | | 64 |
| 199B - 19DA | 6556 - 6619 | Wave Scope samples for channel Ia | SINT16 | -32768 to +32767 | | | 64 |
| 19DB - 1A1A | 6620 - 6683 | Wave Scope samples for channel Vb | SINT16 | -32768 to +32767 | | | 64 |
| 1A1B - 1A5A | 6684 - 6747 | Wave Scope samples for channel Ib | SINT16 | -32768 to +32767 | | | 64 |
| 1A5B - 1A9A | 6748 - 6811 | Wave Scope samples for channel Vc | SINT16 | -32768 to +32767 | | | 64 |
| 1A9B - 1ADA | 6812 - 6875 | Wave Scope samples for channel Ic | SINT16 | -32768 to +32767 | | | 64 |
| | | | | | | Block Size: | 876 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| **Short term Primary Minimum Block** | | | | | | **read-only** | |
| 1F27 - 1F28 | 7976 - 7977 | Volts A-N, previous Demand interval Short Term Minimum | FLOAT | 0 to 9999 M | volts | | 2 |
| 1F29 - 1F2A | 7978 - 7979 | Volts B-N, previous Demand interval Short Term Minimum | FLOAT | 0 to 9999 M | volts | | 2 |
| 1F2B - 1F2C | 7980 - 7981 | Volts C-N, previous Demand interval Short Term Minimum | FLOAT | 0 to 9999 M | volts | | 2 |
| 1F2D - 1F2E | 7982 - 7983 | Volts A-B, previous Demand interval Short Term Minimum | FLOAT | 0 to 9999 M | volts | Minimum instantaneous value measured during the demand interval before the one most recently completed. | 2 |
| 1F2F - 1F30 | 7984 - 7985 | Volts B-C, previous Demand interval Short Term Minimum | FLOAT | 0 to 9999 M | volts | | 2 |
| 1F31 - 1F32 | 7986 - 7987 | Volts C-A, previous Demand interval Short Term Minimum | FLOAT | 0 to 9999 M | volts | | 2 |
| 1F33 - 1F34 | 7988 - 7989 | Volts A-N, Short Term Minimum | FLOAT | 0 to 9999 M | volts | | 2 |
| 1F35 - 1F36 | 7990 - 7991 | Volts B-N, Short Term Minimum | FLOAT | 0 to 9999 M | volts | | 2 |
| 1F37 - 1F38 | 7992 - 7993 | Volts C-N, Short Term Minimum | FLOAT | 0 to 9999 M | volts | | 2 |
| 1F39 - 1F3A | 7994 - 7995 | Volts A-B, Short Term Minimum | FLOAT | 0 to 9999 M | volts | Minimum instantaneous value measured during the most recently completed demand interval. | 2 |
| 1F3B - 1F3C | 7996 - 7997 | Volts B-C, Short Term Minimum | FLOAT | 0 to 9999 M | volts | | 2 |
| 1F3D - 1F3E | 7998 - 7999 | Volts C-A, Short Term Minimum | FLOAT | 0 to 9999 M | volts | | 2 |
| | | | | | | Block Size: | 24 |
| **Primary Minimum Block** | | | | | | **read-only** | |
| 1F3F - 1F40 | 8000 - 8001 | Volts A-N, Minimum | FLOAT | 0 to 9999 M | volts | | 2 |
| 1F41 - 1F42 | 8002 - 8003 | Volts B-N, Minimum | FLOAT | 0 to 9999 M | volts | | 2 |
| 1F43 - 1F44 | 8004 - 8005 | Volts C-N, Minimum | FLOAT | 0 to 9999 M | volts | | 2 |
| 1F45 - 1F46 | 8006 - 8007 | Volts A-B, Minimum | FLOAT | 0 to 9999 M | volts | | 2 |
| 1F47 - 1F48 | 8008 - 8009 | Volts B-C, Minimum | FLOAT | 0 to 9999 M | volts | | 2 |
| 1F49 - 1F4A | 8010 - 8011 | Volts C-A, Minimum | FLOAT | 0 to 9999 M | volts | | 2 |
| 1F4B - 1F4C | 8012 - 8013 | Amps A, Minimum Avg Demand | FLOAT | 0 to 9999 M | amps | | 2 |
| 1F4D - 1F4E | 8014 - 8015 | Amps B, Minimum Avg Demand | FLOAT | 0 to 9999 M | amps | | 2 |
| 1F4F - 1F50 | 8016 - 8017 | Amps C, Minimum Avg Demand | FLOAT | 0 to 9999 M | amps | | 2 |
| 1F51 - 1F52 | 8018 - 8019 | Positive Watts, 3-Ph, Minimum Avg Demand | FLOAT | 0 to +9999 M | watts | | 2 |
| 1F53 - 1F54 | 8020 - 8021 | Positive VARs, 3-Ph, Minimum Avg Demand | FLOAT | 0 to +9999 M | VARs | | 2 |
| 1F55 - 1F56 | 8022 - 8023 | Negative Watts, 3-Ph, Minimum Avg Demand | FLOAT | 0 to +9999 M | watts | | 2 |
| 1F57 - 1F58 | 8024 - 8025 | Negative VARs, 3-Ph, Minimum Avg Demand | FLOAT | 0 to +9999 M | VARs | | 2 |
| 1F59 - 1F5A | 8026 - 8027 | VAs, 3-Ph, Minimum Avg Demand | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 1F5B - 1F5C | 8028 - 8029 | Positive Power Factor, 3-Ph, Minimum Avg Demand | FLOAT | -1.00 to +1.00 | none | | 2 |
| 1F5D - 1F5E | 8030 - 8031 | Negative Power Factor, 3-Ph, Minimum Avg Demand | FLOAT | -1.00 to +1.00 | none | | 2 |
| 1F5F - 1F60 | 8032 - 8033 | Frequency, Minimum | FLOAT | 0 to 65.00 | Hz | | 2 |
| 1F61 - 1F62 | 8034 - 8035 | Neutral Current, Minimum Avg Demand | FLOAT | 0 to 9999 M | amps | | 2 |
| 1F63 - 1F64 | 8036 - 8037 | Positive Watts, Phase A, Minimum Avg Demand | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 1F65 - 1F66 | 8038 - 8039 | Positive Watts, Phase B, Minimum Avg Demand | FLOAT | -9999 M to +9999 M | watts | | 2 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| 1F67 - 1F68 | 8040 - 8041 | Positive Watts, Phase C, Minimum Avg Demand | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 1F69 - 1F6A | 8042 - 8043 | Positive VARs, Phase A, Minimum Avg Demand | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 1F6B - 1F6C | 8044 - 8045 | Positive VARs, Phase B, Minimum Avg Demand | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 1F6D - 1F6E | 8046 - 8047 | Positive VARs, Phase C, Minimum Avg Demand | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 1F6F - 1F70 | 8048 - 8049 | Negative Watts, Phase A, Minimum Avg Demand | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 1F71 - 1F72 | 8050 - 8051 | Negative Watts, Phase B, Minimum Avg Demand | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 1F73 - 1F74 | 8052 - 8053 | Negative Watts, Phase C, Minimum Avg Demand | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 1F75 - 1F76 | 8054 - 8055 | Negative VARs, Phase A, Minimum Avg Demand | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 1F77 - 1F78 | 8056 - 8057 | Negative VARs, Phase B, Minimum Avg Demand | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 1F79 - 1F7A | 8058 - 8059 | Negative VARs, Phase C, Minimum Avg Demand | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 1F7B - 1F7C | 8060 - 8061 | VAs, Phase A, Minimum Avg Demand | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 1F7D - 1F7E | 8062 - 8063 | VAs, Phase B, Minimum Avg Demand | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 1F7F - 1F80 | 8064 - 8065 | VAs, Phase C, Minimum Avg Demand | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 1F81 - 1F82 | 8066 - 8067 | Positive PF, Phase A, Minimum Avg Demand | FLOAT | -1.00 to +1.00 | none | | 2 |
| 1F83 - 1F84 | 8068 - 8069 | Positive PF, Phase B, Minimum Avg Demand | FLOAT | -1.00 to +1.00 | none | | 2 |
| 1F85 - 1F86 | 8070 - 8071 | Positive PF, Phase C, Minimum Avg Demand | FLOAT | -1.00 to +1.00 | none | | 2 |
| 1F87 - 1F88 | 8072 - 8073 | Negative PF, Phase A, Minimum Avg Demand | FLOAT | -1.00 to +1.00 | none | | 2 |
| 1F89 - 1F8A | 8074 - 8075 | Negative PF, Phase B, Minimum Avg Demand | FLOAT | -1.00 to +1.00 | none | | 2 |
| 1F8B - 1F8C | 8076 - 8077 | Negative PF, Phase C, Minimum Avg Demand | FLOAT | -1.00 to +1.00 | none | | 2 |
| 1F8D - 1F8D | 8078 - 8078 | Volts A-N, %THD, Minimum | UINT16 | 0 to 9999 | 0.01% | | 1 |
| 1F8E - 1F8E | 8079 - 8079 | Volts B-N, %THD, Minimum | UINT16 | 0 to 9999 | 0.01% | | 1 |
| 1F8F - 1F8F | 8080 - 8080 | Volts C-N, %THD, Minimum | UINT16 | 0 to 9999 | 0.01% | | 1 |
| 1F90 - 1F90 | 8081 - 8081 | Amps A, %THD, Minimum | UINT16 | 0 to 9999 | 0.01% | | 1 |
| 1F91 - 1F91 | 8082 - 8082 | Amps B, %THD, Minimum | UINT16 | 0 to 9999 | 0.01% | | 1 |
| 1F92 - 1F92 | 8083 - 8083 | Amps C, %THD, Minimum | UINT16 | 0 to 9999 | 0.01% | | 1 |
| 1F93 - 1F94 | 8084 - 8085 | Symmetrical Component Magnitude, 0 Seq, Minimum | FLOAT | 0 to 9999 M | volts | | 2 |
| 1F95 - 1F96 | 8086 - 8087 | Symmetrical Component Magnitude, + Seq, Minimum | FLOAT | 0 to 9999 M | volts | | 2 |
| 1F97 - 1F98 | 8088 - 8089 | Symmetrical Component Magnitude, - Seq, Minimum | FLOAT | 0 to 9999 M | volts | | 2 |
| 1F99 - 1F99 | 8090 - 8090 | Symmetrical Component Phase, 0 Seq, Minimum | SINT16 | -1800 to +1800 | 0.1 degree | | 1 |
| 1F9A - 1F9A | 8091 - 8091 | Symmetrical Component Phase, + Seq, Minimum | SINT16 | -1800 to +1800 | 0.1 degree | | 1 |
| 1F9B - 1F9B | 8092 - 8092 | Symmetrical Component Phase, - Seq, Minimum | SINT16 | -1800 to +1800 | 0.1 degree | | 1 |
| 1F9C - 1F9C | 8093 - 8093 | Unbalance, 0 sequence, Minimum | UINT16 | 0 to 65535 | 0.01% | | 1 |
| 1F9D - 1F9D | 8094 - 8094 | Unbalance, -sequence, Minimum | UINT16 | 0 to 65535 | 0.01% | | 1 |
| 1F9E - 1F9E | 8095 - 8095 | Current Unbalance, Minimum | UINT16 | 0 to 20000 | 0.01% | | 1 |
| | | | | | | Block Size: | 96 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| **Primary Minimum Timestamp Block** | | | | | | **read-only** | |
| 20CF - 20D1 | 8400 - 8402 | Volts A-N, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 20D2 - 20D4 | 8403 - 8405 | Volts B-N, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 20D5 - 20D7 | 8406 - 8408 | Volts C-N, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 20D8 - 20DA | 8409 - 8411 | Volts A-B, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 20DB - 20DD | 8412 - 8414 | Volts B-C, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 20DE - 20E0 | 8415 - 8417 | Volts C-A, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 20E1 - 20E3 | 8418 - 8420 | Amps A, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 20E4 - 20E6 | 8421 - 8423 | Amps B, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 20E7 - 20E9 | 8424 - 8426 | Amps C, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 20EA - 20EC | 8427 - 8429 | Positive Watts, 3-Ph, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 20ED - 20EF | 8430 - 8432 | Positive VARs, 3-Ph, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 20F0 - 20F2 | 8433 - 8435 | Negative Watts, 3-Ph, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 20F3 - 20F5 | 8436 - 8438 | Negative VARs, 3-Ph, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 20F6 - 20F8 | 8439 - 8441 | VAs, 3-Ph, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 20F9 - 20FB | 8442 - 8444 | Positive Power Factor, 3-Ph, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 20FC - 20FE | 8445 - 8447 | Negative Power Factor, 3-Ph, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 20FF - 2101 | 8448 - 8450 | Frequency, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2102 - 2104 | 8451 - 8453 | Neutral Current, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2100 | 1 sec | | 3 |
| 2105 - 2107 | 8454 - 8456 | Positive Watts, Phase A, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2108 - 210A | 8457 - 8459 | Positive Watts, Phase B, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 210B - 210D | 8460 - 8462 | Positive Watts, Phase C, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 210E - 2110 | 8463 - 8465 | Positive VARs, Phase A, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2111 - 2113 | 8466 - 8468 | Positive VARs, Phase B, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2114 - 2116 | 8469 - 8471 | Positive VARs, Phase C, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2117 - 2119 | 8472 - 8474 | Negative Watts, Phase A, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 211A - 211C | 8475 - 8477 | Negative Watts, Phase B, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 211D - 211F | 8478 - 8480 | Negative Watts, Phase C, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2120 - 2122 | 8481 - 8483 | Negative VARs, Phase A, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2123 - 2125 | 8484 - 8486 | Negative VARs, Phase B, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2126 - 2128 | 8487 - 8489 | Negative VARs, Phase C, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2129 - 212B | 8490 - 8492 | VAs, Phase A, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 212C - 212E | 8493 - 8495 | VAs, Phase B, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 212F - 2131 | 8496 - 8498 | VAs, Phase C, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2132 - 2134 | 8499 - 8501 | Positive PF, Phase A, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2135 - 2137 | 8502 - 8504 | Positive PF, Phase B, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| 2138 - 213A | 8505 - 8507 | Positive PF, Phase C, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 213B - 213D | 8508 - 8510 | Negative PF, Phase A, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 213E - 2140 | 8511 - 8513 | Negative PF, Phase B, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2141 - 2143 | 8514 - 8516 | Negative PF, Phase C, Min Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2144 - 2146 | 8517 - 8519 | Volts A-N, %THD, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2147 - 2149 | 8520 - 8522 | Volts B-N, %THD, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 214A - 214C | 8523 - 8525 | Volts C-N, %THD, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 214D - 214F | 8526 - 8528 | Amps A, %THD, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2150 - 2152 | 8529 - 8531 | Amps B, %THD, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2153 - 2155 | 8532 - 8534 | Amps C, %THD, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2156 - 2158 | 8535 - 8537 | Symmetrical Comp Magnitude, 0 Seq, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2159 - 215B | 8538 - 8540 | Symmetrical Comp Magnitude, + Seq, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 215C - 215E | 8541 - 8543 | Symmetrical Comp Magnitude, - Seq, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 215F - 2161 | 8544 - 8546 | Symmetrical Comp Phase, 0 Seq, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2162 - 2164 | 8547 - 8549 | Symmetrical Comp Phase, + Seq, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2165 - 2167 | 8550 - 8552 | Symmetrical Comp Phase, - Seq, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2168 - 2170 | 8553 - 8555 | Unbalance, 0 Seq, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2171 - 2173 | 8556 - 8558 | Unbalance, - Seq, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2174 - 2176 | 8559 - 8561 | Current Unbalance, Min Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| | | | | | | Block Size: | 162 |
| **Short term Primary Maximum Block** | | | | | | **read-only** | |
| 230F - 2310 | 8976 - 8977 | Volts A-N, previous Demand interval Short Term Maximum | FLOAT | 0 to 9999 M | volts | Maximum instantaneous value measured during the demand interval before the one most recently completed. | |
| 2311 - 2312 | 8978 - 8979 | Volts B-N, previous Demand interval Short Term Maximum | FLOAT | 0 to 9999 M | volts | | |
| 2313 - 2314 | 8980 - 8981 | Volts C-N, previous Demand interval Short Term Maximum | FLOAT | 0 to 9999 M | volts | | |
| 2315 - 2316 | 8982 - 8983 | Volts A-B, previous Demand interval Short Term Maximum | FLOAT | 0 to 9999 M | volts | | |
| 2317 - 2318 | 8984 - 8985 | Volts B-C, previous Demand interval Short Term Maximum | FLOAT | 0 to 9999 M | volts | | |
| 2319 - 231A | 8986 - 8987 | Volts C-A, previous Demand interval Short Term Maximum | FLOAT | 0 to 9999 M | volts | | |
| 231B - 231C | 8988 - 8989 | Volts A-N, Maximum | FLOAT | 0 to 9999 M | volts | Maximum instantaneous value measured during the most recently completed demand interval. | 2 |
| 231D - 231E | 8990 - 8991 | Volts B-N, Maximum | FLOAT | 0 to 9999 M | volts | | 2 |
| 232F - 2320 | 8992 - 8993 | Volts C-N, Maximum | FLOAT | 0 to 9999 M | volts | | 2 |
| 2321 - 2322 | 8994 - 8995 | Volts A-B, Maximum | FLOAT | 0 to 9999 M | volts | | 2 |
| 2323 - 2324 | 8996 - 8997 | Volts B-C, Maximum | FLOAT | 0 to 9999 M | volts | | 2 |
| 2325 - 2326 | 8998 - 8999 | Volts C-A, Maximum | FLOAT | 0 to 9999 M | volts | | 2 |
| | | | | | | Block Size: | 12 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| **Primary Maximum Block** | | | | | | **read-only** | |
| 2327 - 2328 | 9000 - 9001 | Volts A-N, Maximum | FLOAT | 0 to 9999 M | volts | | 2 |
| 2329 - 232A | 9002 - 9003 | Volts B-N, Maximum | FLOAT | 0 to 9999 M | volts | | 2 |
| 232B - 232C | 9004 - 9005 | Volts C-N, Maximum | FLOAT | 0 to 9999 M | volts | | 2 |
| 232D - 232E | 9006 - 9007 | Volts A-B, Maximum | FLOAT | 0 to 9999 M | volts | | 2 |
| 232F - 2330 | 9008 - 9009 | Volts B-C, Maximum | FLOAT | 0 to 9999 M | volts | | 2 |
| 2331 - 2332 | 9010 - 9011 | Volts C-A, Maximum | FLOAT | 0 to 9999 M | volts | | 2 |
| 2333 - 2334 | 9012 - 9013 | Amps A, Maximum Avg Demand | FLOAT | 0 to 9999 M | amps | | 2 |
| 2335 - 2336 | 9014 - 9015 | Amps B, Maximum Avg Demand | FLOAT | 0 to 9999 M | amps | | 2 |
| 2337 - 2338 | 9016 - 9017 | Amps C, Maximum Avg Demand | FLOAT | 0 to 9999 M | amps | | 2 |
| 2339 - 233A | 9018 - 9019 | Positive Watts, 3-Ph, Maximum Avg Demand | FLOAT | 0 to +9999 M | watts | | 2 |
| 233B - 233C | 9020 - 9021 | Positive VARs, 3-Ph, Maximum Avg Demand | FLOAT | 0 to +9999 M | VARs | | 2 |
| 233D - 233E | 9022 - 9023 | Negative Watts, 3-Ph, Maximum Avg Demand | FLOAT | 0 to +9999 M | watts | | 2 |
| 233F - 2340 | 9024 - 9025 | Negative VARs, 3-Ph, Maximum Avg Demand | FLOAT | 0 to +9999 M | VARs | | 2 |
| 2341 - 2342 | 9026 - 9027 | VAs, 3-Ph, Maximum Avg Demand | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 2343 - 2344 | 9028 - 9029 | Positive Power Factor, 3-Ph, Maximum Avg Demand | FLOAT | -1.00 to +1.00 | none | | 2 |
| 2345 - 2346 | 9030 - 9031 | Negative Power Factor, 3-Ph, Maximum Avg Demand | FLOAT | -1.00 to +1.00 | none | | 2 |
| 2347 - 2348 | 9032 - 9033 | Frequency, Maximum | FLOAT | 0 to 65.00 | Hz | | 2 |
| 2349 - 234A | 9034 - 9035 | Neutral Current, Maximum Avg Demand | FLOAT | 0 to 9999 M | amps | | 2 |
| 234B - 234C | 9036 - 9037 | Positive Watts, Phase A, Maximum Avg Demand | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 234D - 234E | 9038 - 9039 | Positive Watts, Phase B, Maximum Avg Demand | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 234F - 2350 | 9040 - 9041 | Positive Watts, Phase C, Maximum Avg Demand | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 2351 - 2352 | 9042 - 9043 | Positive VARs, Phase A, Maximum Avg Demand | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 2353 - 2354 | 9044 - 9045 | Positive VARs, Phase B, Maximum Avg Demand | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 2355 - 2356 | 9046 - 9047 | Positive VARs, Phase C, Maximum Avg Demand | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 2357 - 2358 | 9048 - 9049 | Negative Watts, Phase A, Maximum Avg Demand | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 2359 - 235A | 9050 - 9051 | Negative Watts, Phase B, Maximum Avg Demand | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 235B - 235C | 9052 - 9053 | Negative Watts, Phase C, Maximum Avg Demand | FLOAT | -9999 M to +9999 M | watts | | 2 |
| 235D - 235E | 9054 - 9055 | Negative VARs, Phase A, Maximum Avg Demand | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 235F - 2360 | 9056 - 9057 | Negative VARs, Phase B, Maximum Avg Demand | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 2361 - 2362 | 9058 - 9059 | Negative VARs, Phase C, Maximum Avg Demand | FLOAT | -9999 M to +9999 M | VARs | | 2 |
| 2363 - 2364 | 9060 - 9061 | VAs, Phase A, Maximum Avg Demand | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 2365 - 2366 | 9062 - 9063 | VAs, Phase B, Maximum Avg Demand | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 2367 - 2368 | 9064 - 9065 | VAs, Phase C, Maximum Avg Demand | FLOAT | -9999 M to +9999 M | VAs | | 2 |
| 2369 - 236A | 9066 - 9067 | Positive PF, Phase A, Maximum Avg Demand | FLOAT | -1.00 to +1.00 | none | | 2 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| 236B - 236C | 9068 - 9069 | Positive PF, Phase B, Maximum Avg Demand | FLOAT | -1.00 to +1.00 | none | | 2 |
| 236D - 236E | 9070 - 9071 | Positive PF, Phase C, Maximum Avg Demand | FLOAT | -1.00 to +1.00 | none | | 2 |
| 236F - 2370 | 9072 - 9073 | Negative PF, Phase A, Maximum Avg Demand | FLOAT | -1.00 to +1.00 | none | | 2 |
| 2371 - 2372 | 9074 - 9075 | Negative PF, Phase B, Maximum Avg Demand | FLOAT | -1.00 to +1.00 | none | | 2 |
| 2373 - 2374 | 9076 - 9077 | Negative PF, Phase C, Maximum Avg Demand | FLOAT | -1.00 to +1.00 | none | | 2 |
| 2375 - 2375 | 9078 - 9078 | Volts A-N, %THD, Maximum | UINT16 | 0 to 9999 | 0.01% | | 1 |
| 2376 - 2376 | 9079 - 9079 | Volts B-N, %THD, Maximum | UINT16 | 0 to 9999 | 0.01% | | 1 |
| 2377 - 2377 | 9080 - 9080 | Volts C-N, %THD, Maximum | UINT16 | 0 to 9999 | 0.01% | | 1 |
| 2378 - 2378 | 9081 - 9081 | Amps A, %THD, Maximum | UINT16 | 0 to 9999 | 0.01% | | 1 |
| 2379 - 2379 | 9082 - 9082 | Amps B, %THD, Maximum | UINT16 | 0 to 9999 | 0.01% | | 1 |
| 237A - 237A | 9083 - 9083 | Amps C, %THD, Maximum | UINT16 | 0 to 9999 | 0.01% | | 1 |
| 237B - 237C | 9084 - 9085 | Symmetrical Component Magnitude, 0 Seq, Maximum | FLOAT | 0 to 9999 M | volts | | 2 |
| 237D - 237E | 9086 - 9087 | Symmetrical Component Magnitude, + Seq, Maximum | FLOAT | 0 to 9999 M | volts | | 2 |
| 237F - 2380 | 9088 - 9089 | Symmetrical Component Magnitude, - Seq, Maximum | FLOAT | 0 to 9999 M | volts | | 2 |
| 2381 - 2381 | 9090 - 9090 | Symmetrical Component Phase, 0 Seq, Maximum | SINT16 | -1800 to +1800 | 0.1 degree | | 1 |
| 2382 - 2382 | 9091 - 9091 | Symmetrical Component Phase, + Seq, Maximum | SINT16 | -1800 to +1800 | 0.1 degree | | 1 |
| 2383 - 2383 | 9092 - 9092 | Symmetrical Component Phase, - Seq, Maximum | SINT16 | -1800 to +1800 | 0.1 degree | | 1 |
| 2384 - 2384 | 9093 - 9093 | Unbalance, 0 Seq, Maximum | UINT16 | 0 to 65535 | 0.01% | | 1 |
| 2385 - 2385 | 9094 - 9094 | Unbalance, - Seq, Maximum | UINT16 | 0 to 65535 | 0.01% | | 1 |
| 2386 - 2386 | 9095 - 9095 | Current Unbalance, Maximum | UINT16 | 0 to 20000 | 0.01% | | 1 |
| | | | | | | Block Size: | 96 |
| **Primary Maximum Timestamp Block** | | | | | | **read-only** | |
| 24B7 - 24B9 | 9400 - 9402 | Volts A-N, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24BA - 24BC | 9403 - 9405 | Volts B-N, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24BD - 24BF | 9406 - 9408 | Volts C-N, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24C0 - 24C2 | 9409 - 9411 | Volts A-B, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24C3 - 24C5 | 9412 - 9414 | Volts B-C, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24C6 - 24C8 | 9415 - 9417 | Volts C-A, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24C9 - 24CB | 9418 - 9420 | Amps A, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24CC - 24CE | 9421 - 9423 | Amps B, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24CF - 24D1 | 9424 - 9426 | Amps C, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24D2 - 24D4 | 9427 - 9429 | Positive Watts, 3-Ph, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24D5 - 24D7 | 9430 - 9432 | Positive VARs, 3-Ph, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24D8 - 24DA | 9433 - 9435 | Negative Watts, 3-Ph, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24DB - 24DD | 9436 - 9438 | Negative VARs, 3-Ph, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24DE - 24E0 | 9439 - 9441 | VAs, 3-Ph, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24E1 - 24E3 | 9442 - 9444 | Positive Power Factor, 3-Ph, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24E4 - 24E6 | 9445 - 9447 | Negative Power Factor, 3-Ph, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24E7 - 24E9 | 9448 - 9450 | Frequency, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| 24EA - 24EC | 9451 - 9453 | Neutral Current, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2100 | 1 sec | | 3 |
| 24ED - 24EF | 9454 - 9456 | Positive Watts, Phase A, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24F0 - 24F2 | 9457 - 9459 | Positive Watts, Phase B, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24F3 - 24F5 | 9460 - 9462 | Positive Watts, Phase C, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24F6 - 24F8 | 9463 - 9465 | Positive VARs, Phase A, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24F9 - 24FB | 9466 - 9468 | Positive VARs, Phase B, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24FC - 24FE | 9469 - 9471 | Positive VARs, Phase C, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 24FF - 2501 | 9472 - 9474 | Negative Watts, Phase A, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2502 - 2504 | 9475 - 9477 | Negative Watts, Phase B, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2505 - 2507 | 9478 - 9480 | Negative Watts, Phase C, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2508 - 250A | 9481 - 9483 | Negative VARs, Phase A, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 250B - 250D | 9484 - 9486 | Negative VARs, Phase B, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 250E - 2510 | 9487 - 9489 | Negative VARs, Phase C, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2511 - 2513 | 9490 - 9492 | VAs, Phase A, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2514 - 2516 | 9493 - 9495 | VAs, Phase B, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2517 - 2519 | 9496 - 9498 | VAs, Phase C, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 251A - 251C | 9499 - 9501 | Positive PF, Phase A, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 251D - 251F | 9502 - 9504 | Positive PF, Phase B, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2520 - 2522 | 9505 - 9507 | Positive PF, Phase C, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2523 - 2525 | 9508 - 9510 | Negative PF, Phase A, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2526 - 2528 | 9511 - 9513 | Negative PF, Phase B, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2529 - 252B | 9514 - 9516 | Negative PF, Phase C, Max Avg Dmd Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 252C - 252E | 9517 - 9519 | Volts A-N, %THD, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 252F - 2531 | 9520 - 9522 | Volts B-N, %THD, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2532 - 2534 | 9523 - 9525 | Volts C-N, %THD, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2535 - 2537 | 9526 - 9528 | Amps A, %THD, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2538 - 253A | 9529 - 9531 | Amps B, %THD, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 253B - 253D | 9532 - 9534 | Amps C, %THD, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 253E - 2540 | 9535 - 9537 | Symmetrical Comp Magnitude, 0 Seq, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2541 - 2543 | 9538 - 9540 | Symmetrical Comp Magnitude, + Seq, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2544 - 2546 | 9541 - 9543 | Symmetrical Comp Magnitude, - Seq, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2547 - 2549 | 9544 - 9546 | Symmetrical Comp Phase, 0 Seq, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| 254A - 254C | 9547 - 9549 | Symmetrical Comp Phase, + Seq, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 254D - 254F | 9550 - 9552 | Symmetrical Comp Phase, - Seq, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2550 - 2552 | 9553 - 9555 | Unbalance, 0 Seq, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2553 - 2555 | 9556 - 9558 | Unbalance, - Seq, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| 2556 - 2558 | 9559 - 9561 | Current Unbalance, Max Timestamp | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| | | | | | | Block Size: | 159 |
| ***Option Card 1 Section*** | | | | | | | |
| **Card Identification and Configuration Block (Note 14)** | | | | | | **read-only** | |
| 270F - 270F | 10000 - 10000 | Class ID and card status | UINT16 | bit-mapped | undv-----ccccttttt | Flags active if bit is set: u=unsupported card; n=card need configuration; d=card is using default configuration; v=communication with card is ok<br>Field: cccc=class of installed card.<br>Field tttt=type of card. See note 22 | 1 |
| 2710 - 2710 | 10001 - 10001 | Reserved | | | | Reserved | 1 |
| 2711 - 2718 | 10002 - 10009 | Card name | ASCII | 16 char | none | ASCII name of the installed card | 8 |
| 2719 - 2720 | 10010 - 10017 | Serial number | ASCII | 16 char | none | Serial Number in ASCII of the installed card | 8 |
| 2721 - 2722 | 10018 - 10019 | Version | ASCII | 4 char | none | Version in ASCII of the hardware of the installed card. | 2 |
| 2723 - 2746 | 10020 - 10055 | Reserved | | | | Reserved | 36 |
| 2747 - 2748 | 10056 - 10057 | Firmware Version | ASCII | 4 char | none | Version of the BOOT firmware of the card, left justified and padded with spaces. Blank for boards without embedded firmware. | 2 |
| 2749 - 274A | 10058 - 10059 | Firmware Version | ASCII | 4 char | none | Version of the RUN firmware of the card, left justified and padded with spaces. Blank for boards without embedded firmware. | 2 |
| 274B - 274E | 10060 - 10063 | Reserved | | | | Reserved | 4 |
| | | | | | | Block Size: | 64 |
| **Current Communication Settings for Option Card 1** | | | | | | **Read-only** | |
| 274F - 274F | 10064 - 10064 | Current speed and format | UINT16 | bit-mapped | -abcde-- fghijklm | Bps: a=57600; b=38400; c=19200; d=14400; e=9600<br>Stop bits 'f': cleared 1 stop bit, set 2 stop bits<br>Parity: g=even; h=odd; i=none<br>Data bits: j=8; k=7; l=6; m=5 | 1 |
| 2750 - 2750 | 10065 - 10065 | Reserved | UINT16 | bit-mapped | | Reserved | 1 |
| 2751 - 2751 | 10066 - 10066 | Current protocol | UINT16 | bit-mapped | -------- -----ppp- | ppp=protocol<br>100=DNP3; 010=Ascii Modbus; 001=Rtu Modbus | 1 |
| 2752 - 2752 | 10067 - 10067 | Current reply delay | UINT16 | 0 to 65535 | milliseconds | Delay to reply to a Modbus transaction after receiving it. | 1 |
| 2753 - 2756 | 10068 - 10071 | Reserved | | | | Reserved | 4 |
| | | | | | | Block Size: | 8 |
| **Data and Control Blocks for Option Card 1** | | | | | | **read-only** | |
| 2757 - 2790 | 10072 - 10129 | Data and Control Block for Option Card 1. Meaning of registers depends on installed card. -- see below | | | | Register assignments depend on which type of card is in the slot. See overlays below. | 58 |
| | | | | | | Block Size: | 66 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| ***Expansions for Data and Control Block for Option Card 1*** | | | | | | | |
| **Data and Control Block -- Digital I/O Relay Card Overlay (Note 15)** | | | | | | **read-only except as indicated** | |
| 2757 - 2757 | 10072 - 10072 | Digital Input States | UINT16 | bit-mapped | -------- 22221111 | Two nibble fields: (2222) for input#2 and (1111) for input #1.<br>Lsb in each nibble is the current state of the input. Msb in each nibble is the oldest registered state. | 1 |
| 2758 - 2758 | 10073 - 10073 | Digital Relay States | UINT16 | bit-mapped | -------- --ab--cd | If "a" is 1 then state of Relay#2 is unknown, otherwise state of Relay#2 is in "c": (1=tripped, 0=released).<br>If "b" is 1 then state of Relay#1 is unknown, otherwise state of Relay#1 is in "d": (1=tripped, 0=released). | 1 |
| 2759 - 2759 | 10074 - 10074 | Turn relay on | UINT16 | bit-mapped | -------- ------21 | Writing a 1 in bit N turns relay N+1 ON (this register is writeable only in privileged session) | 1 |
| 275A - 275A | 10075 - 10075 | Turn relay off | UINT16 | bit-mapped | -------- ------21 | Writing a 1 in bit N turns relay N+1 OFF (this register is writeable only in privileged session) | 1 |
| 275B - 275B | 10076 - 10076 | Trip/Release delay timer for Relay 1 | UINT16 | 0 to 9999 | 0.1 sec | time to trip or release | 1 |
| 275C - 275C | 10077 - 10077 | Trip/Release delay timer for Relay 2 | UINT16 | 0 to 9999 | 0.1 sec | time to trip or release | 1 |
| 275D - 275E | 10078 - 10079 | Reserved | | | | Reserved | 2 |
| 275F - 275F | 10080 - 10080 | Input 1 Accumulator, Scaled | UINT16 | 0 to 9999 | resolution is 1, 10, 100, 1000, 10000, or 100000 counts | Disabled accumulators always read 0. | 1 |
| 2760 - 2760 | 10081 - 10081 | Input 2 Accumulator, Scaled | UINT16 | 0 to 9999 | | | 1 |
| 2761 - 2762 | 10082 - 10083 | Reserved | | | | Reserved | 2 |
| 2763 - 2763 | 10084 - 10084 | Relay 1 Accumulator, Scaled | UINT16 | 0 to 9999 | resolution is 1, 10, 100, 1000, 10000, or 100000 counts | Disabled accumulators always read 0. | 1 |
| 2764 - 2764 | 10085 - 10085 | Relay 2 Accumulator, Scaled | UINT16 | 0 to 9999 | | | 1 |
| 2765 - 2790 | 10086 - 10129 | Reserved | | | | Reserved | 44 |
| | | | | | | Block Size: | 58 |
| **Data and Control Block -- Digital I/O Pulse Output Card Overlay (Note 15)** | | | | | | **read-only except as indicated** | |
| 2757 - 2757 | 10072 - 10072 | Digital Input States | UINT16 | bit-mapped | dddd cccc bbbb aaaa | Nibble "dddd" for input#4, "cccc" for input#3, "bbbb" for input#2 and "aaaa" for input#1.<br>Within each field, rightmost bit is the current state (1=closed, 0=open), and bits at left are the older states 100ms apart. (historical states)<br>Example:<br>xxxx xxxx xxxx 0011<br>Current state of input#1 is closed, before that it was closed too, before that it was open and the oldest state known is open. | 1 |
| 2758 - 2758 | 10073 - 10073 | Digital Output States | UINT16 | bit-mapped | -------- ----4321 | One bit for each output. Bit 4 is for output #4, and bit 1 is for output #1. If a bit is set the output is closed, otherwise it is opened. | 1 |
| 2759 - 2759 | 10074 - 10074 | Pulse Output Test Select | UINT16 | bit-mapped | -------- ----4321 | Write 1 to a bit to set its corresponding Pulse Output into test mode. Write 0 to restore it to normal operation. A privileged session is required to write the bits. Reading this register reports the mode for each output (1=under test, 0=normal). | 1 |
| 275A - 275A | 10075 - 10075 | Pulse Output Test Power | UINT16 | bit-mapped | ddvvvvvv vvvvvvvv | This register is Writeable in privileged session only. Simulates constant Power for the Pulse Output under test. Format is same as Kt settings for Pulse Output.<br>"V" is raw value in Wh/pulse from 0 to 9999.<br>"dd"=decimal point position: 00=0.XXXX, 01=X.XXX, 10=XX.XX, 11= XXX.X | 1 |
| 275B - 275E | 10076 - 10079 | Reserved | | | | Reserved | 4 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| 275F - 275F | 10080 - 10080 | Input 1 Accumulator, Scaled | UINT16 | 0 to 9999 | resolution is 1, 10, 100, 1000, 10000, or 100000 counts | Disabled accumulators always read 0. | 1 |
| 2760 - 2760 | 10081 - 10081 | Input 2 Accumulator, Scaled | UINT16 | 0 to 9999 | | | 1 |
| 2761 - 2761 | 10082 - 10082 | Input 3 Accumulator, Scaled | UINT16 | 0 to 9999 | | | 1 |
| 2762 - 2762 | 10083 - 10083 | Input 4 Accumulator, Scaled | UINT16 | 0 to 9999 | | | 1 |
| 2763 - 2763 | 10084 - 10084 | Output 1 Accumulator, Scaled | UINT16 | 0 to 9999 | | | 1 |
| 2764 - 2764 | 10085 - 10085 | Output 2 Accumulator, Scaled | UINT16 | 0 to 9999 | | | 1 |
| 2765 - 2765 | 10086 - 10086 | Output 3 Accumulator, Scaled | UINT16 | 0 to 9999 | | | 1 |
| 2766 - 2766 | 10087 - 10087 | Output 4 Accumulator, Scaled | UINT16 | 0 to 9999 | | | 1 |
| 2767 - 2790 | 10088 - 10129 | Reserved | | | | Reserved | 42 |
| | | | | | | Block Size: | 58 |
| **Data and Control Block--Analog Out 0-1mA / Analog Out 4-20mA (Note 15)** | | | | | | **read-only** | |
| 2757 - 2757 | 10072 - 10072 | Status of card | UINT16 | bit-mapped | ----cf-- -------- | Flag fields:<br>c=calibration not good; f=configuration error | 1 |
| 2758 - 2790 | 10073 - 10129 | Reserved | | | | Reserved | 57 |
| | | | | | | Block Size: | 58 |
| **Data and Control Block -- Network Card Overlay (Note 15)** | | | | | | **read-only** | |
| 2757 - 2757 | 10072 - 10072 | Card and Network Status | UINT16 | bit-mapped | rhp----- sfw-m-ii | Flags: r=run mode; h=card is healthy; p=using last good known programmable settings<br>Server flags: s=smtp ok; f=ftp ok; w=web server ok; m=modbus tcp/ip ok.<br>IP Status ii: 00=IP not valid yet, 01=IP from p.settings; 10=IP from DHCP;11=using last good known IP. | 1 |
| 2758 - 2758 | 10073 - 10073 | Reserved | | | | Reserved | 1 |
| 2759 - 275B | 10074 - 10076 | MAC address in use by the network card | UINT16 | bit-mapped | 6 bytes | These 3 registers hold the 6 bytes of the card's ethernet MAC address | 3 |
| 275C - 275F | 10077 - 10080 | Current IP Address | UINT16 | | | These 4 registers hold the 4 numbers (1 number each register) that make the IP address used by the card. | 4 |
| 2760 - 2760 | 10081 - 10081 | Current IP Mask Length | UINT16 | 0 to 32 | | Number of bits that are set in the IP address mask, starting from the Msb of the 32 bit word.<br>Example 24 = 255.255.255.0; a value of 2 would mean 192.0.0.0 | 1 |
| 2761 - 2762 | 10082 - 10083 | Firmware Version | ASCII | 4 char | none | Version of the BOOT firmware of the card, left justified and padded with spaces. Blank for boards without embedded firmware. | 2 |
| 2763 - 2764 | 10084 - 10085 | Firmware Version | ASCII | 4 char | none | Version of the RUN firmware of the card, left justified and padded with spaces. Blank for boards without embedded firmware. | 2 |
| 2765 - 2790 | 10086 - 10129 | Reserved | | | | Reserved for Extended Nw Status | 44 |
| | | | | | | Block Size: | 58 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| ***Option Card 2 Section*** | | | | | | | |
| **Card Identification and Configuration Block (Note 14)** | | | | | | **read-only** | |
| 2AF7 - 2AF7 | 11000 - 11000 | Class ID and card status | UINT16 | bit-mapped | undv-----ccccttttt | Flags active if bit is set: u=unsupported card; n=card need configuration; d=card is using default configuration; v=communication with card is ok<br>Field: cccc=class of installed card.<br>Field tttt=type of card. See note 22 | 1 |
| 2AF8 - 2AF8 | 11001 - 11001 | Reserved | | | | Read only | 1 |
| 2AF9 - 2B00 | 11002 - 11009 | Card name | ASCII | 16 char | none | ASCII name of the installed card | 8 |
| 2B01 - 2B08 | 11010 - 11017 | Serial number | ASCII | 16 char | none | Serial Number in ASCII of the installed card | 8 |
| 2B09 - 2B0A | 11018 - 11019 | Version | ASCII | 4 char | none | Version in ASCII of the hardware of the installed card. | 2 |
| 2B0B - 2B28 | 11020 - 11055 | Reserved | | | | Reserved | 36 |
| 2B2F - 2B30 | 11056 - 11057 | Firmware Version | ASCII | 4 char | none | Version of the BOOT firmware of the card, left justified and padded with spaces. Blank for boards without embedded firmware. | 2 |
| 2B31 - 2B32 | 11058 - 11059 | Firmware Version | ASCII | 4 char | none | Version of the RUN firmware of the card, left justified and padded with spaces. Blank for boards without embedded firmware. | 2 |
| 2B33 - 2B36 | 11060 - 11063 | Reserved | | | | Reserved | 4 |
| | | | | | | Block Size: | 64 |
| **Current Communication Settings for Option Card 2** | | | | | | **Read-only** | |
| 2B37 - 2B37 | 11064 - 11064 | Current speed and format | UINT16 | bit-mapped | -abcde-- fghijklm | Bps: a=57600; b=38400; c=19200; d=14400; e=9600<br>Stop bits 'f': cleared 1 stop bit, set 2 stop bits<br>Parity: g=even; h=odd; i=none<br>Data bits: j=8; k=7; l=6; m=5 | 1 |
| 2B38 - 2B38 | 11065 - 11065 | Reserved | UINT16 | bit-mapped | | Reserved | 1 |
| 2B39 - 2B39 | 11066 - 11066 | Current protocol | UINT16 | bit-mapped | -------- -----ppp- | ppp=protocol<br>100=DNP3; 010=Ascii Modbus; 001=Rtu Modbus | 1 |
| 2B3A - 2B3A | 11067 - 11067 | Current reply delay | UINT16 | 0 to 65535 | milliseconds | Delay to reply a Modbus transaction after receiving it. | 1 |
| 2B3B - 2B3E | 11068 - 11071 | Reserved | | | | Reserved | 4 |
| | | | | | | Block Size: | 8 |
| **Data and Control Blocks for Option Card 2** | | | | | | **read-only** | |
| 2B3F - 2B78 | 11072 - 11129 | Data and Control Block for Option Card 2<br>Meaning of registers depend on installed card. -- see below | | | | Register assignments depend on which type of card is in the slot. See overlays below. | 58 |
| | | | | | | Block Size: | 66 |
| ***Expansions for Data and Control Block for Option Card 2*** | | | | | | | |
| **Data and Control Block -- Digital I/O Relay Card Overlay (Note 15)** | | | | | | **read-only except as indicated** | |
| 2B3F - 2B3F | 11072 - 11072 | Digital Input States | UINT16 | bit-mapped | -------- 22221111 | Two nibble fields: (2222) for input#2 and (1111) for input #1.<br>Lsb in each nibble is the current state of the input. Msb in each nibble is the oldest registered state. | 1 |
| 2B40 - 2B40 | 11073 - 11073 | Digital Relay States | UINT16 | bit-mapped | -------- --ab--cd | If "a" is 1 then state of Relay#2 is unknown, otherwise state of Relay#2 is in "c": (1=tripped, 0=released).<br>If "b" is 1 then state of Relay#1 is unknown, otherwise state of Relay#1 is in "d": (1=tripped, 0=released). | 1 |
| 2B41 - 2B41 | 11074 - 11074 | Turn relay on | UINT16 | bit-mapped | -------- ------21 | Writing a 1 in bit N turns relay N+1 ON (this register is writeable only in privileged session) | 1 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| 2B42 - 2B42 | 11075 - 11075 | Turn relay off | UINT16 | bit-mapped | -------- ------21 | Writing a 1 in bit N turns relay N+1 OFF (this register is writeable only in privileged session) | 1 |
| 2B43 - 2B43 | 11076 - 11076 | Trip/Release delay timer for Relay 1 | UINT16 | 0 to 9999 | 0.1 sec | time to trip or release | 1 |
| 2B44 - 2B44 | 11077 - 11077 | Trip/Release delay timer for Relay 2 | UINT16 | 0 to 9999 | 0.1 sec | time to trip or release | 1 |
| 2B45 - 2B46 | 11078 - 11079 | Reserved | | | | Reserved | 2 |
| 2B47 - 2B47 | 11080 - 11080 | Input 1 Accumulator, Scaled | UINT16 | 0 to 9999 | resolution is 1, 10, 100, 1000, 10000, or 100000 counts | Disabled accumulators always read 0. | 1 |
| 2B48 - 2B48 | 11081 - 11081 | Input 2 Accumulator, Scaled | UINT16 | 0 to 9999 | | | 1 |
| 2B49 - 2B4A | 11082 - 11083 | Reserved | | | | Reserved | 2 |
| 2B4B - 2B4B | 11084 - 11084 | Relay 1 Accumulator, Scaled | UINT16 | 0 to 9999 | resolution is 1, 10, 100, 1000, 10000, or 100000 counts | Disabled accumulators always read 0. | 1 |
| 2B4C - 2B4C | 11085 - 11085 | Relay 2 Accumulator, Scaled | UINT16 | 0 to 9999 | | | 1 |
| 2B4D - 2B78 | 11086 - 11129 | Reserved | | | | Reserved | 44 |
| | | | | | | Block Size: | 58 |
| **Data and Control Block -- Digital I/O Pulse Output Card Overlay (Note 15)** | | | | | | **read-only except as indicated** | |
| 2B3F - 2B3F | 11072 - 11072 | Digital Input States | UINT16 | bit-mapped | dddd cccc bbbb aaaa | Nibble "dddd" for input#4, "cccc" for input#3, "bbbb" for input#2 and "aaaa" for input#1.<br>Within each field, right most bit is the current state (1=closed, 0=open), and bits at left are the older states 100ms apart. (historical states)<br>Example:<br>xxxx xxxx xxxx 0011<br>Current state of input#1 is closed, before that it was closed too, before that it was open and the oldest state known is open. | 1 |
| 2B40 - 2B40 | 11073 - 11073 | Digital Output States | UINT16 | bit-mapped | -------- ----4321 | One bit for each output. Bit 4 is for output #4, and bit 1 is for output #1. If a bit is set the output is closed, otherwise it is opened. | 1 |
| 2B41 - 2B41 | 11074 - 11074 | Pulse Output Test Select | UINT16 | bit-mapped | -------- ----4321 | Write 1 to a bit to set its corresponding Pulse Output into test mode. Write 0 to restore it to normal operation. A privileged session is required to write the bits. Reading this register reports the mode for each output (1=under test, 0=normal). | 1 |
| 2B42 - 2B42 | 11075 - 11075 | Pulse Output Test Power | UINT16 | bit-mapped | ddvvvvvv vvvvvvvv | This register is Writeable in privileged session only. Simulates constant Power for the Pulse Output under test. Format is same as Kt settings for Pulse Output.<br>"V" is raw value in Wh/pulse from 0 to 9999.<br>"dd"=decimal point position: 00=0.XXXX, 01=X.XXX, 10=XX.XX, 11= XXX.X | 1 |
| 2B43 - 2B46 | 11076 - 11079 | Reserved | | | | Reserved | 4 |
| 2B47 - 2B47 | 11080 - 11080 | Input 1 Accumulator, Scaled | UINT16 | 0 to 9999 | resolution is 1, 10, 100, 1000, 10000, or 100000 counts | Disabled accumulators always read 0. | 1 |
| 2B48 - 2B48 | 11081 - 11081 | Input 2 Accumulator, Scaled | UINT16 | 0 to 9999 | | | 1 |
| 2B49 - 2B49 | 11082 - 11082 | Input 3 Accumulator, Scaled | UINT16 | 0 to 9999 | | | 1 |
| 2B4A - 2B4A | 11083 - 11083 | Input 4 Accumulator, Scaled | UINT16 | 0 to 9999 | | | 1 |
| 2B4B - 2B4B | 11084 - 11084 | Output 1 Accumulator, Scaled | UINT16 | 0 to 9999 | | | 1 |
| 2B4C - 2B4C | 11085 - 11085 | Output 2 Accumulator, Scaled | UINT16 | 0 to 9999 | | | 1 |
| 2B4D - 2B4D | 11086 - 11086 | Output 3 Accumulator, Scaled | UINT16 | 0 to 9999 | | | 1 |
| 2B4E - 2B4E | 11087 - 11087 | Output 4 Accumulator, Scaled | UINT16 | 0 to 9999 | | | 1 |
| 2B4F - 2B78 | 11088 - 11129 | Reserved | | | | Reserved | 42 |
| | | | | | | Block Size: | 58 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| **Data and Control Block--Analog Out 0-1mA / Analog Out 4-20mA (Note 15)** | | | | | | **read-only** | |
| 2B3F - 2B3F | 11072 - 11072 | Status of card | UINT16 | bit-mapped | ----cf-- -------- | Flag fields:<br>c=calibration not good; f=configuration error | 1 |
| 2B40 - 2B78 | 11073 - 11129 | Reserved | UINT16 | | | Reserved | 57 |
| | | | | | | Block Size: | 58 |
| **Data and Control Block -- Network Card Overlay (Note 15)** | | | | | | **read-only** | |
| 2B3F - 2B3F | 11072 - 11072 | Card and Network Status | UINT16 | bit-mapped | rhp----- sfw-m-ii | Flags: r=run mode; h=card is healthy; p=using last good known programmable settings<br>Server flags: s=smtp ok; f=ftp ok; w=web server ok; m=modbus tcp/ip ok.<br>IP Status ii: 00=IP not valid yet, 01=IP from p.settings; 10=IP from DHCP;11=using last good known IP. | 1 |
| 2B40 - 2B40 | 11073 - 11073 | Reserved | | | | Reserved | 1 |
| 2B41 - 2B43 | 11074 - 11076 | MAC address in use by the network card | UINT16 | bit-mapped | 6 bytes | These 3 registers hold the 6 bytes of the card's Ethernet MAC address. | 3 |
| 2B44 - 2B47 | 11077 - 11080 | Current IP Address | UINT16 | | | These 4 registers hold the 4 numbers (1 number each register) that make the IP address used by the card. | 4 |
| 2B48 - 2B48 | 11081 - 11081 | Current IP Mask Length | UINT16 | 0 to 32 | | Number of bits that are set in the IP address mask, starting from the Msb of the 32 bit word.<br>Example 24 = 255.255.255.0; a value of 2 would mean 192.0.0.0 | 1 |
| 2B49 - 2B4A | 11082 - 11083 | Firmware Version | ASCII | 4 char | none | Version of the BOOT firmware of the card, left justified and padded with spaces. Blank for boards without embedded firmware. | 2 |
| 2B4B - 2B4C | 11084 - 11085 | Firmware Version | ASCII | 4 char | none | Version of the RUN firmware of the card, left justified and padded with spaces. Blank for boards without embedded firmware. | 2 |
| 2B4D - 2B78 | 11086 - 11129 | Reserved | | | | Reserved for Extended Nw Status | 44 |
| | | | | | | Block Size: | 58 |
| **Accumulators Block** | | | | | | **read-only** | |
| 2EDF - 2EE0 | 12000 - 12001 | Option Card 1, Input 1 Accumulator | UINT32 | 0 to 999999999 | number of transitions | These are unscaled counts. See option card section for scaled versions.<br>Input accumulators count either or both transitions; output accumulators count both transitions.<br>Unused accumulators always read 0. | 2 |
| 2EE1 - 2EE6 | 12002 - 12007 | Option Card 1, Inputs 2-4 Accumulators | UINT32 | 0 to 999999999 | number of transitions | | 6 |
| 2EE7 - 2EE8 | 12008 - 12009 | Option Card 1, Output or Relay 1 Accumulator | UINT32 | 0 to 999999999 | number of transitions | | 2 |
| 2EE9 - 2EEE | 12010 - 12015 | Option Card 1, Output or Relays 2-4 | UINT32 | 0 to 999999999 | number of transitions | | 6 |
| 2EEF - 2EF6 | 12016 - 12023 | Option Card 2 Inputs Accumulators | UINT32 | 0 to 999999999 | number of transitions | | 8 |
| 2EF7 - 2EFE | 12024 - 12031 | Option Card 2 Outputs Accumulators | UINT32 | 0 to 999999999 | number of transitions | | 8 |
| | | | | | | Block Size: | 32 |
| ***Commands Section (Note 4)*** | | | | | | | |
| **Resets Block (Note 9)** | | | | | | **write-only** | |
| 4E1F - 4E1F | 20000 - 20000 | Reset Max/Min Blocks | UINT16 | password (Note 5) | | | 1 |
| 4E20 - 4E20 | 20001 - 20001 | Reset Energy Accumulators | UINT16 | password (Note 5) | | | 1 |
| 4E21 - 4E21 | 20002 - 20002 | Reset Alarm Log (Note 21) | UINT16 | password (Note 5) | | Reply to a reset log command indicates that the command was accepted but not necessarily that the reset is finished. Poll log status block to determine this. | 1 |
| 4E22 - 4E22 | 20003 - 20003 | Reset System Log (Note 21) | UINT16 | password (Note 5) | | | 1 |
| 4E23 - 4E23 | 20004 - 20004 | Reset Historical Log 1 (Note 21) | UINT16 | password (Note 5) | | | 1 |
| 4E24 - 4E24 | 20005 - 20005 | Reset Historical Log 2 (Note 21) | UINT16 | password (Note 5) | | | 1 |
| 4E25 - 4E25 | 20006 - 20006 | Reset Historical Log 3 (Note 21) | UINT16 | password (Note 5) | | | 1 |
| 4E26 - 4E26 | 20007 - 20007 | Reset I/O Change Log (Note 21) | UINT16 | password (Note 5) | | | 1 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| 4E27 - 4E27 | 20008 - 20008 | Reset Power Quality Log | UINT16 | password (Note 5) | | | 1 |
| 4E28 - 4E28 | 20009 - 20009 | Reset Waveform Capture Log | UINT16 | password (Note 5) | | | 1 |
| 4E29 - 4E2A | 20010 - 20011 | Reserved | | | | Reserved | 2 |
| 4E2B - 4E2B | 20012 - 20012 | Reset Option Card 1 Input Accumulators | UINT16 | password (Note 5) | | | 1 |
| 4E2C - 4E2C | 20013 - 20013 | Reset Option Card 1 Output Accumulators | UINT16 | password (Note 5) | | | 1 |
| 4E2D - 4E2D | 20014 - 20014 | Reset Option Card 2 Input Accumulators | UINT16 | password (Note 5) | | | 1 |
| 4E2E - 4E2E | 20015 - 20015 | Reset Option Card 2 Output Accumulators | UINT16 | password (Note 5) | | | 1 |
| | | | | | | Block Size: | 16 |
| | | | | | | | |
| **Privileged Commands Block** | | | | | | **conditional write** | |
| 5207 - 5207 | 21000 - 21000 | Initiate Meter Firmware Reprogramming | UINT16 | password (Note 5) | | | 1 |
| 5208 - 5208 | 21001 - 21001 | Force Meter Restart | UINT16 | password (Note 5) | | causes a watchdog reset, always reads 0 | 1 |
| 5209 - 5209 | 21002 - 21002 | Open Privileged Command Session | UINT16 | password (Note 5) | | meter will process command registers (this register through 'Close Privileged Command Session' register below) for 5 minutes or until the session is closed, whichever comes first. | 1 |
| 520A - 520A | 21003 - 21003 | Initiate Programmable Settings Update | UINT16 | password (Note 5) | | meter enters PS update mode | 1 |
| 520B - 520B | 21004 - 21004 | Calculate Programmable Settings Checksum (Note 3) | UINT16 | 0000 to 9999 | | meter calculates checksum on RAM copy of PS block | 1 |
| 520C - 520C | 21005 - 21005 | Programmable Settings Checksum (Note 3) | UINT16 | 0000 to 9999 | | read/write checksum register; PS block saved in nonvolatile memory on write (Note 8) | 1 |
| 520D - 520D | 21006 - 21006 | Write New Password (Note 3) | UINT16 | 0000 to 9999 | | write-only register; always reads zero | 1 |
| 520E - 520E | 21007 - 21007 | Terminate Programmable Settings Update (Note 3) | UINT16 | any value | | meter leaves PS update mode via reset | 1 |
| 520F - 5211 | 21008 - 21010 | Set Meter Clock | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | saved only when 3rd register is written | 3 |
| 5212 - 5212 | 21011 - 21011 | Manually Trigger Waveform Capture | UINT16 | any value | | applies to Shark 300 only; returns busy exception if blocked by another capture in progress | 1 |
| 5213 - 5219 | 21012 - 21018 | Reserved | | | | Reserved | 7 |
| 521A - 521A | 21019 - 21019 | Close Privileged Command Session | UINT16 | any value | | ends an open command session | 1 |
| | | | | | | Block Size: | 20 |
| **Encryption Block** | | | | | | **read/write** | |
| 658F - 659A | 26000 - 26011 | Perform a Secure Operation | UINT16 | | | encrypted command to read password or change meter type | 12 |
| | | | | | | Block Size: | 12 |
| ***Programmable Settings Section*** | | | | | | | |
| **Basic Setups Block** | | | | | | **write only in PS update mode** | |
| 752F - 752F | 30000 - 30000 | CT multiplier & denominator | UINT16 | bit-mapped | dddddddd mmmmmmmm | high byte is denominator (1 or 5, read-only), low byte is multiplier (1, 10, or 100) | 1 |
| 7530 - 7530 | 30001 - 30001 | CT numerator | UINT16 | 1 to 9999 | none | | 1 |
| 7531 - 7531 | 30002 - 30002 | PT numerator | UINT16 | 1 to 9999 | none | | 1 |
| 7532 - 7532 | 30003 - 30003 | PT denominator | UINT16 | 1 to 9999 | none | | 1 |
| 7533 - 7533 | 30004 - 30004 | PT multiplier & hookup | UINT16 | bit-mapped | mmmmmmmm mmmmhhhh | mm…mm = PT multiplier (1, 10, 100, or 1000)<br>hhhh = hookup enumeration (0 = 3 element wye[9S], 1 = delta 2 CTs[5S], 3 = 2.5 element wye[6S]) | 1 |
| 7534 - 7534 | 30005 - 30005 | Averaging Method | UINT16 | bit-mapped | --iiiiii b---sss | iiiiii = interval (5,15,30,60)<br>b = 0-block or 1-rolling<br>sss = # subintervals (1,2,3,4) | 1 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| 7535 - 7535 | 30006 - 30006 | Power & Energy Format | UINT16 | bit-mapped | ppppiinn feee-ddd | pppp = power scale (0-unit, 3-kilo, 6-mega, 8-auto)<br>ii = power digits after decimal point (0-3),<br>applies only if f=1 and pppp is not auto<br>nn = number of energy digits (5-8 --> 0-3)<br>eee = energy scale (0-unit, 3-kilo, 6-mega)<br>f = decimal point for power<br>(0=data-dependant placement,<br>1=fixed placement per ii value)<br>ddd = energy digits after decimal point (0-6)<br>See note 10. | 1 |
| 7536 - 7536 | 30007 - 30007 | Operating Mode Screen Enables | UINT16 | bit-mapped | -------x eeeeeeee | eeeeeeee = op mode screen rows on/off, rows top to bottom are bits low order to high order<br>x = set to suppress PF on W/VAR/PF screens | 1 |
| 7537 - 7537 | 30008 - 30008 | Daylight Saving On Rule | UINT16 | bit-mapped | hhhhhwww -dddmmmm | applies only if daylight savings in User Settings Flags = on; specifies when to make changeover<br>hhhhh = hour, 0-23<br>www = week, 1-4 for 1st - 4th, 5 for last<br>ddd = day of week, 1-7 for Sun - Sat<br>mmmm = month, 1-12<br>Example: 2AM on the 4th Sunday of March<br>hhhhh=2, www=4, ddd=1, mmmm=3 | 1 |
| 7538 - 7538 | 30009 - 30009 | Daylight Saving Off Rule | UINT16 | bit-mapped | hhhhhwww -dddmmmm | | 1 |
| 7539 - 7539 | 30010 - 30010 | Time Zone UTC offset | UINT16 | bit-mapped | z000 0000 hhhh hhmm | mm = minutes/15; 00=00, 01=15, 10=30, 11=45<br>hhhhhh = hours; -23 to +23<br>z = Time Zone valid (0=no, 1=yes)<br>i.e. register=0 indicates that time zone is not set while register=0x8000 indicates UTC offset = 0 | 1 |
| 753A - 753A | 30011 - 30011 | Clock Sync Configuration | UINT16 | bit-mapped | 0000 0000 mmmp pppe | e = enable automatic clock sync (0=no, 1=yes)<br>mmm = sync method (1=NTP, 4=Line, all other values=no sync)<br>pppp = method-dependent paramter.<br>NTP pppp=port performing synchronization (2-3 = COM3-COM4).<br>Line pppp=expected frequency (0=60 Hz, 1=50 Hz) | 1 |
| 753B - 753B | 30012 - 30012 | Reserved | | | | Reserved | 1 |
| 753C - 753C | 30013 - 30013 | User Settings 2 | UINT16 | bit-mapped | -------- ccccccc s | ccccccc = under range voltage cutoff, 0 to 12.7 % full scale in .1% steps. Vrms below this value is reported as 0. See note 12 for full scale information.<br>s = display secondary volts (1=yes, 0=no) | 1 |
| 753D - 753D | 30014 - 30014 | DNP Options | UINT16 | bit-mapped | -------- ww-i-vvp | p selects primary or secondary values for DNP voltage, current and power registers<br>(0=secondary, 1=primary)<br>vv sets divisor for voltage scaling<br>(0=1, 1=10, 2=100)<br>i sets divisor for current scaling<br>(0=1, 1=10)<br>ww sets divisor for power scaling in addition to scaling for Kilo<br>(0=1, 1=10, 2=100, 3=1000)<br>Example:<br>120KV, 500A, 180MW<br>p=1, vv=2, i=0, and ww=3<br>voltage reads 1200, current reads 500, watts reads 180 | 1 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| 753E - 753E | 30015 - 30015 | User Settings Flags | UINT16 | bit-mapped | vvkgeinn srpdywfa | vv = number of digits after decimal point for voltage display.<br>0 - For voltage range (0 - 9999V)<br>1 - For voltage range (100.0kV - 999.9 kV)<br>2 - For voltage range (10.00kV - 99.99 kV)<br>3 - For voltage range ( 0kV - 9.999 kV)<br>This setting is used only when k=1.<br>k = enable fixed scale for voltage display.<br>(0=autoscale, 1=unit if vv=0 and kV if vv=1,2,3 )<br>g = enable alternate full scale bar graph current<br>(1=on, 0=off)<br>e = enable ct pt compensation<br>(0=Disabled, 1=Enabled).<br>i = fixed scale and format current display<br>0=normal autoscaled current display<br>1=always show amps with no decimal places<br>nn = number of phases for voltage & current screen<br>(3=ABC, 2=AB, 1=A, 0=ABC)<br>s = scroll (1=on, 0=off)<br>r = password for reset in use (1=on, 0=off)<br>p = password for configuration in use (1=on, 0=off)<br>d = daylight saving time changes (0=off, 1=on)<br>y = diagnostic events in system log (1=yes, 0=no)<br>w = power direction<br>(0=view as load, 1=view as generator)<br>f = flip power factor sign (1=yes, 0=no)<br>a = apparent power computation method | 1 |
| 753F - 753F | 30016 - 30016 | Full Scale Current (for load % bar graph) | UINT16 | 0 to 9999 | none | If non-zero and user settings bit g is set, this value replaces CT numerator in the full scale current calculation. (See Note 12) | 1 |
| 7540 - 7547 | 30017 - 30024 | Meter Designation | ASCII | 16 char | none | | 8 |
| 7548 - 7548 | 30025 - 30025 | COM1 setup | UINT16 | bit-mapped | ----dddd -0100110 | yy = parity (0-none, 1-odd, 2-even)<br>dddd = reply delay (* 50 msec)<br>ppp = protocol (1-Modbus RTU, 2-Modbus ASCII, 3-DNP)<br>bbbb = baud rate (1-9600, 2-19200, 4-38400, 6-57600, 13=1200, 14=2400, 15=4800) | 1 |
| 7549 - 7549 | 30026 - 30026 | COM2 setup | UINT16 | bit-mapped | yy--dddd -pppbbbb | | 1 |
| 754A - 754A | 30027 - 30027 | COM2 address | UINT16 | 1 to 247 | none | | 1 |
| 754B - 754B | 30028 - 30028 | Limit #1 Identifier | UINT16 | 0 to 65535 | | use Modbus address as the identifier (see notes 7, 11, 12) | 1 |
| 754C - 754C | 30029 - 30029 | Limit #1 Out High Setpoint | SINT16 | -200.0 to +200.0 | 0.1% of full scale | Setpoint for the "above" limit (LM1), see notes 11-12. | 1 |
| 754D - 754D | 30030 - 30030 | Limit #1 In High Threshold | SINT16 | -200.0 to +200.0 | 0.1% of full scale | Threshold at which "above" limit clears; normally less than or equal to the "above" setpoint; see notes 11-12. | 1 |
| 754E - 754E | 30031 - 30031 | Limit #1 Out Low Setpoint | SINT16 | -200.0 to +200.0 | 0.1% of full scale | Setpoint for the "below" limit (LM2), see notes 11-12. | 1 |
| 754F - 754F | 30032 - 30032 | Limit #1 In Low Threshold | SINT16 | -200.0 to +200.0 | 0.1% of full scale | Threshold at which "below" limit clears; normally greater than or equal to the "below" setpoint; see notes 11-12. | 1 |
| 7550 - 7554 | 30033 - 30037 | Limit #2 | SINT16 | same as Limit #1 | same as Limit #1 | same as Limit #1 | 5 |
| 7555 - 7559 | 30038 - 30042 | Limit #3 | SINT16 | | | | 5 |
| 755A - 755E | 30043 - 30047 | Limit #4 | SINT16 | | | | 5 |
| 755F - 7563 | 30048 - 30052 | Limit #5 | SINT16 | | | | 5 |
| 7564 - 7568 | 30053 - 30057 | Limit #6 | SINT16 | | | | 5 |
| 7569 - 756D | 30058 - 30062 | Limit #7 | SINT16 | | | | 5 |
| 756E - 7572 | 30063 - 30067 | Limit #8 | SINT16 | | | | 5 |
| 7573 - 7582 | 30068 - 30083 | Reserved | | | | Reserved | 16 |
| 7583 - 75C2 | 30084 - 30147 | Reserved | | | | Reserved | 64 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| 75C3 - 75C3 | 30148 - 30148 | watts loss due to iron when watts positive | UINT16 | 0 to 99.99 | 0.01% | | 1 |
| 75C4 - 75C4 | 30149 - 30149 | watts loss due to copper when watts positive | UINT16 | 0 to 99.99 | 0.01% | | 1 |
| 75C5 - 75C5 | 30150 - 30150 | var loss due to iron when watts positive | UINT16 | 0 to 99.99 | 0.01% | | 1 |
| 75C6 - 75C6 | 30151 - 30151 | var loss due to copper when watts positive | UINT16 | 0 to 99.99 | 0.01% | | 1 |
| 75C7 - 75C3 | 30152 - 30152 | watts loss due to iron when watts negative | UINT16 | 0 to 99.99 | 0.01% | | 1 |
| 75C8 - 75C48 | 30153 - 30153 | watts loss due to copper when watts negative | UINT16 | 0 to 99.99 | 0.01% | | 1 |
| 75C9 - 75C9 | 30154 - 30154 | var loss due to iron when watts negative | UINT16 | 0 to 99.99 | 0.01% | | 1 |
| 75CA - 75CA | 30155 - 30155 | var loss due to copper when watts negative | UINT16 | 0 to 99.99 | 0.01% | | 1 |
| 75CB - 75CB | 30156 - 30156 | transformer loss compensation user settings flag | UINT16 | bit-mapped | -------- ----cfwv | c - 0 disable compensation for losses due to copper,<br>1 enable compensaion for losses due to copper<br>f - 0 disable compensation for losses due to iron,<br>1 enable compensaion for losses due to iron<br>w - 0 add watt compensation,<br>1 subtract watt compensation<br>v - 0 add var compensation,<br>1 subtract var compensation | 1 |
| 75CC - 75E5 | 30157 - 30182 | Reserved | | | | Reserved | 26 |
| 75E6 - 75E6 | 30183 - 30183 | Programmable Settings Update Counter | UINT16 | 0-65535 | | Increments each time programmable settings are changed; occurs when new checksum is calculated. | 1 |
| 75E7 - 7626 | 30184 - 30247 | Reserved for Software Use | | | | Reserved | 64 |
| 7627 - 7627 | 30248 - 30248 | A phase PT compensation @ 69V (% error) | SINT16 | -15 to 15 | 0.01% | | 1 |
| 7628 - 7628 | 30249 - 30249 | A phase PT compensation @ 120V (% error) | SINT16 | -15 to 15 | 0.01% | | 1 |
| 7629 - 7629 | 30250 - 30250 | A phase PT compensation @ 230V (% error) | SINT16 | -15 to 15 | 0.01% | | 1 |
| 762A - 762A | 30251 - 30251 | A phase PT compensation @ 480V (% error) | SINT16 | -15 to 15 | 0.01% | | 1 |
| 762B - 762B | 30252 - 30255 | B phase PT compensation @ 69V, 120V, 230V, 480V (% error) | SINT16 | -15 to 15 | 0.01% | | 4 |
| 762F - 762F | 30256 - 30259 | C phase PT compensation @ 69V, 120V, 230V, 480V (% error) | SINT16 | -15 to 15 | 0.01% | | 4 |
| 7633 - 7633 | 30260 - 30260 | A phase CT compensation @ c1 (% error) | SINT16 | -15 to 15 | 0.01% | For Class 10 unit<br>c1=0.25A<br>c2=0.5A<br>c3=1A<br>c4=5A<br><br>For Class 2 unit<br>c1=0.05A<br>c2=0.1A<br>c3=0.2A<br>c4=1A | 1 |
| 7634 - 7634 | 30261 - 30261 | A phase CT compensation @ c2 (% error) | SINT16 | -15 to 15 | 0.01% | | 1 |
| 7635 - 7635 | 30262 - 30262 | A phase CT compensation @ c3 (% error) | SINT16 | -15 to 15 | 0.01% | | 1 |
| 7636 - 7636 | 30263 - 30263 | A phase CT compensation @ c4 (% error) | SINT16 | -15 to 15 | 0.01% | | 1 |
| 7637 - 7637 | 30264 - 30267 | B phase CT compensation @ c1, c2, c3, c4 (% error) | SINT16 | -15 to 15 | 0.01% | | 4 |
| 763B - 763E | 30268 - 30271 | C phase CT compensation @ c1, c2, c3, c4 (% error) | SINT16 | -15 to 15 | 0.01% | | 4 |
| 763F - 7642 | 30272 - 30275 | A phase PF compensation @ c1, c2, c3, c4 | SINT16 | -50 to 50 | | | 4 |
| 7643 - 7646 | 30276 - 30279 | B phase PF compensation @ c1, c2, c3, c4 | SINT16 | -50 to 50 | | | 4 |
| 7647 - 764A | 30280 - 30283 | C phase PF compensation @ c1, c2, c3, c4 | SINT16 | -50 to 50 | | | 4 |
| | | | | | | Block Size: | 284 |
| | | | | | | | |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| **Log Setups Block** | | | | | | **write only in PS update mode** | |
| 7917 - 7917 | 31000 - 31000 | Historical Log #1 Sizes | UINT16 | bit-mapped | eeeeeeee ssssssss | high byte is number of registers to log in each record (0-117),<br>low byte is number of flash sectors for the log (see note 19)<br>0 in either byte disables the log | 1 |
| 7918 - 7918 | 31001 - 31001 | Historical Log #1 Interval | UINT16 | bit-mapped | 00000000 hgfedcba | only 1 bit set: a=1 min, b=3 min, c=5 min, d=10 min, e=15 min, f=30 min, g=60 min, h=EOI pulse | 1 |
| 7919 - 7919 | 31002 - 31002 | Historical Log #1, Register #1 Identifier | UINT16 | 0 to 65535 | | use Modbus address as the identifier (see note 7) | 1 |
| 791A - 798D | 31003 - 31118 | Historical Log #1, Register #2 - #117 Identifiers | UINT16 | 0 to 65535 | | same as Register #1 Identifier | 116 |
| 798E - 79D6 | 31119 - 31191 | Historical Log #1 Software Buffer | | | | Reserved for software use. | 73 |
| 79D7 - 7A96 | 31192 - 31383 | Historical Log #2 Sizes, Interval, Registers & Software Buffer | same as Historical Log #1 | | | | 192 |
| 7A97 - 7B56 | 31384 - 31575 | Historical Log #3 Sizes, Interval, Registers & Software Buffer | same as Historical Log #1 | | | | 192 |
| 7B57 - 7B57 | 31576 - 31607 | Waveform Log Sample Rate & Pretrigger | UINT16 | bit-mapped | ssssssss pppppppp | High byte is samples/60Hz cycle = 5(32), 6(64), 7(128), 8(256), or 9(512)<br>Low byte is number of pretrigger cycles. | 1 |
| 7B58 - 7B58 | 31577 - 31577 | Power Quality Log Triggers | UINT16 | bit-mapped | -------8 76543210 | Set bits to enable PQ events/waveform captures.<br>2,1,0 = Voltage Surge, channel C,B,A | 1 |
| 7B59 - 7B59 | 31578 - 31578 | Waveform Log Triggers | UINT16 | bit-mapped | -------8 76543210 | 5,4,3 = Current Surge, channel C, B, A<br>8,7,6 = Voltage Sag, channel C, B, A | 1 |
| 7B5A - 7B5A | 31579 - 31579 | Waveform & PQ Log Sizes | UINT16 | bit-mapped | pppppppp wwwwwwww | High byte is number of flash sectors for PQ log,<br>Low byte is number of flash sectors for waveform log | 1 |
| 7B5B - 7B5B | 31580 - 31580 | Reserved | | | | Reserved | 1 |
| 7B5C - 7B5C | 31581 - 31581 | Channel A Voltage Surge Threshold | UINT16 | 0 to 3276.7 | 0.1% of full scale | | 1 |
| 7B5D - 7B5D | 31582 - 31582 | Channel A Current Surge Threshold | UINT16 | 0 to 3276.7 | 0.1% of full scale | Thresholds are % of full scale, see note 12 | 1 |
| 7B5E - 7B5E | 31583 - 31583 | Channel A Voltage Sag Threshold | UINT16 | 0 to 3276.7 | 0.1% of full scale | | 1 |
| 7B5F - 7B61 | 31584 - 31586 | Reserved | | | | Reserved | 3 |
| 7B62 - 7B67 | 31587 - 31592 | Channel B Surge & Sag Thresholds | same as Channel A | | | | 6 |
| 7B68 - 7B6D | 31593 - 31598 | Channel C Surge & Sag Thresholds | same as Channel A | | | | 6 |
| 7B6E - 7B76 | 31599 - 31607 | Reserved | | | | Reserved | 9 |
| | | | | | | Block Size: | 608 |
| ***Programmable Settings for Option Card 1*** | | | | | | | |
| **Option Card 1 Setups Block** | | | | | | **write only in PS update mode** | |
| 7CFF - 7CFF | 32000 - 32000 | Class ID of the Option Card 1 Settings | UINT16 | bit-mapped | -------- cccctttt | Which class (cccc) and type(tttt) of card the Option Settings for Card 1 apply to. See note 22. | 1 |
| 7D00 - 7D3E | 32001 - 32063 | Settings for Option Card 1, First Overlay -- see below | Register assignments depend on which type of card is in the slot. See overlays below. | | | | 63 |
| 7D3F - 7F3E | 32064 - 32575 | Settings for Option Card 1, Second Overlay -- see below | Register assignments depend on which type of card is in the slot. See overlays below. | | | | 512 |
| | | | | | | Block Size: | 576 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| ***Overlays for Option Card 1 Programmable Settings*** | | | | | | | |
| **Settings Registers for any communication capable card, including network and analog cards** | | | | | **First Overlay** | **write only in PS update mode** | |
| 7D00 - 7D00 | 32001 - 32001 | Slave address | UINT16 | 1~247 (for Modbus)<br>1~65534 (for DNP) | none | Slave address of the unit. The communication capable card is always a master.<br>Set to 0 when an analog board is installed. | 1 |
| 7D01 - 7D01 | 32002 - 32002 | Speed and format | UINT16 | bit-mapped | -abcde-- fghijklm | Bps: a=57600; b=38400; c=19200; d=14400; e=9600<br>Stop bits 'f': cleared 1 stop bit, set 2 stop bits<br>Parity: g=even; h=odd; i=none<br>Data bits: j=8; k=7; l=6; m=5<br>Set to 0 when an analog board is installed. | 1 |
| 7D02 - 7D02 | 32003 - 32003 | Reserved | | | | Reserved | 1 |
| 7D03 - 7D03 | 32004 - 32004 | Protocol | UINT16 | bit-mapped | -------- -----ppp- | ppp= 100 =DNP3; 010=Ascii Modbus; 001=Rtu Modbus<br>Set to 0 when an analog board is installed. | 1 |
| 7D04 - 7D04 | 32005 - 32005 | Reply delay | UINT16 | 0 to 65535 | milliseconds | Delay to reply to a Modbus transaction after receiving it.<br>Set to 0 when an analog board is installed | 1 |
| 7D05 - 7D3E | 32006 - 32063 | Reserved | | | | Reserved | 58 |
| | | | | | | Block Size: | 63 |
| | | | | | | | |
| **Settings Registers for Digital I/O Relay Card** | | | | | **First Overlay** | **write only in PS update mode** | |
| 7D00 - 7D00 | 32001 - 32001 | Input#1 - 2 bindings & logging enables | UINT16 | bit-mapped | -------- 2222 1111 | One nibble for each input.<br>Assuming "abcc" as the bits in each nibble:<br>"a": select this input for EOI (End Of Interval)pulse sensing.<br>"b": log this input when pulse is detected<br>"cc": Input event trigger mode - Contact sensing method; 00 = none; 01 = open to close; 10 = close to open; 11 = any change.<br>Every input has an associated internal accumulator (See input Accumulator Scaling), which is incremented every time the input changes according with the trigger mode crieteria "cc" | 1 |
| 7D01 - 7D01 | 32002 - 32002 | Relay #1 Delay to Operate | UINT16 | 0.1 second units | | Delay to operate the relay since request. | 1 |
| 7D02 - 7D02 | 32003 - 32003 | Relay #1 Delay to Release | UINT16 | 0.1 second units | | Delay to release the relay since request. | 1 |
| 7D03 - 7D08 | 32004 - 32009 | Reserved | UINT16 | | | Set to 0. | 6 |
| 7D09 - 7D09 | 32010 - 32010 | Relay #2 Delay to Operate | UINT16 | 0.1 second units | | Delay to operate the relay since request. | 1 |
| 7D0A - 7D0A | 32011 - 32011 | Relay #2 Delay to Release | UINT16 | 0.1 second units | | Delay to release the relay since request. | 1 |
| 7D0B - 7D20 | 32012 - 32033 | Reserved | UINT16 | | | Set to 0. | 22 |
| 7D21 - 7D21 | 32034 - 32034 | Input Accumulators Scaling | UINT16 | bit-mapped | -------- 22221111 | 4 bits per input or output accumulator | 1 |
| 7D22 - 7D22 | 32035 - 32035 | Relay Accumulators Scaling | UINT16 | bit-mapped | -------- 22221111 | The nibble informs what should be the scaling of the accumulator 0=no-scaling, 1=0.1, 2=0.01, 3= 1m, 4=0.1m, 5=0.01m, 6=1u, 7=0.1u; the value 15 disable the accumulator.<br>Example: suppose that the internal input accumulator #1 is 12345, and its corresponding scaling setting is "0011" (3 decimal). Then, the accumulator will be read as: Scaling 3, means 1m or 0.001.<br>Scaled accumulator = 12345 * 0.001 = 12 (Twelve). | 1 |

| Modbus Address Hex | Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 7D23 - 7D23 | 33036 - 33036 | Fast pulse input selector | UINT16 | bit-mapped | p------- -----nnn | When value 'nnn' is non-zero, it determines which of the card inputs will be a fast pulse detection input. The polarity bit 'P' tells the event to be detected: 1=open-to-close; 0=close-to-open. There is no “any-change” detection mode. | 1 |
| 7D24 - 7D3E | 32037 - 32063 | Reserved | | | | Set to 0. | 27 |
| | | | | | | Block Size: | 63 |
| **Settings Registers for Digital I/O Pulse Output Card** | | | | | **First Overlay** | **write only in PS update mode** | |
| 7D00 - 7D00 | 32001 - 32001 | Input#1 - 4 bindings & logging enables | UINT16 | bit-mapped | 44443333 22221111 | One nibble for each input. Assuming "abcc" as the bits in each nibble: "a": select this input for EOI (End Of Interval)pulse sensing. "b": log this input when pulse is detected "cc": Input event trigger mode - Contact sensing method; 00 = none; 01 = open to close; 10 = close to open; 11 = any change. Every input has an associated internal accumulator (See input Accumulator Scaling), which is incremented every time the input changes according with the trigger mode crieteria “cc” | 1 |
| 7D01 - 7D01 | 32002 - 32002 | Source for Pulse Ouput#1 | UINT16 | enumeration | -----ppp ----vvvv | "ppp" (Phase) : 000 = none, 001 = Phase A, 010 = Phase B, 011 = Phase C, 100 = All Phases, 101 = Pulse from EOI(End Of Interval). "vvvv"(Value) : 0000= none, 0001 = Wh, 0010 = +Wh, 0011 = -Wh, 0100= Varh, 0101 = +Varh, 0110 = -Varh, 0111 = VAh, 1000= Received Wh, 1001= Delivered Wh, 1010= Inductive Varh, 1011 = Capacitive Varh | 1 |
| 7D02 - 7D02 | 32003 - 32003 | Kt [Wh/pulse] factor for Pulse Output#1 | UINT16 | bit-mapped | ddVVVVVV VVVVVVVV | "V…V" = not scaled energy value per pulse, from 0 to 9999. "dd"= decimal point position: 00=0.XXXX, 01=X.XXX, 10=XX.XX, 11= X.XXX. | 1 |
| 7D03 - 7D04 | 32004 - 32005 | Output#2 Assignment and Kt | UINT16 | same as Output #1 | | | 2 |
| 7D05 - 7D06 | 32006 - 32007 | Output#3 Assignment and Kt | UINT16 | same as Output #1 | | | 2 |
| 7D07 - 7D08 | 32008 - 32009 | Output#4 Assignment and Kt | UINT16 | same as Output #1 | | | 2 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 7D09 - 7D09 | 32010 - 32010 | Input Accumulators Scaling | UINT16 | bit-mapped | 44443333 22221111 | see Relay Card above | 1 |
| 7D0A - 7D0A | 32011 - 32011 | Output Accumulators Scaling | UINT16 | bit-mapped | 44443333 22221111 | | 1 |
| 7D0B - 7D0B | 32012 - 32012 | Fast pulse input selector | UINT16 | bit-mapped | p------- -----nnn | When value 'nnn' is non-zero, it determines which of the card inputs will be a fast pulse detection input. The polarity bit 'P' tells the event to be detected: 1=open-to-close; 0=close-to-open. There is no “any-change” detection mode. | 1 |
| 7D0C - 7D3E | 32013 - 32063 | Reserved | | | | Reserved | 51 |
| | | | | | | Block Size: | 63 |
| | | | | | | | |
| **Settings Registers for Digital I/O Relay Card** | | | | | **Second Overlay** | **write only in PS update mode** | |
| 7D3F - 7D46 | 32064 - 32071 | Input#1 Label | ASCII | 16 char | | | 8 |
| 7D47 - 7D4E | 32072 - 32079 | Input#1 Low State Name | ASCII | 16 char | | | 8 |
| 7D4F - 7D56 | 32080 - 32087 | Input#1 High State Name | ASCII | 16 char | | | 8 |
| 7D57 - 7D6E | 32088 - 32111 | Input#2 Label and State Names | same as Input#1 | | | | 24 |
| 7D6F - 7D9E | 32112 - 32159 | Reserved | | | | Reserved | 48 |
| 7D9F - 7DA6 | 32160 - 32167 | Relay#1 Label | ASCII | 16 char | | | 8 |
| 7DA7 - 7DAE | 32168 - 32175 | Relay#1 Open State Name | ASCII | 16 char | | | 8 |
| 7DAF - 7DB6 | 32176 - 32183 | Relay#1 Closed State Name | ASCII | 16 char | | | 8 |
| 7DB7 - 7DCE | 32184 - 32207 | Relay#2 Label and State Names | same as Relay#1 | | | | 24 |
| 7DCF - 7DFE | 32208 - 32255 | Reserved | | | | Reserved | 48 |
| 7DFF - 7E06 | 32256 - 32263 | Input#1 Accumulator Label | ASCII | 16 char | | | 8 |
| 7E07 - 7E0E | 32264 - 32271 | Input#2 Accumulator Label | ASCII | 16 char | | | 8 |
| 7E0F - 7E1E | 32272 - 32287 | Reserved | | | | Reserved | 16 |
| 7E1F - 7E1F | 32288 - 32288 | Input#1 Accumulator Kt | UINT16 | bit-mapped | ddVVVVVV VVVVVVVV | KT power factor for the Pulse Output "V" is raw power value in Wh/pulse from 0 to 9999. "dd"=decimal point position: 00=0.XXXX, 01=X.XXX, 10=XX.XX, 11= X.XXX. | 1 |
| 7E20 - 7E20 | 32289 - 32289 | Input#2 Accumulator Kt | UINT16 | bit-mapped | ddVVVVVV VVVVVVVV | | 1 |
| 7E21 - 7F3E | 32290 - 32575 | Reserved | | | | Reserved | 286 |
| | | | | | | Block Size: | 512 |
| **Settings Registers for Digital I/O Pulse Output Card** | | | | | **Second Overlay** | **write only in PS update mode** | |
| 7D3F - 7D46 | 32064 - 32071 | Input#1 Label | ASCII | 16 char | | | 8 |
| 7D47 - 7D4E | 32072 - 32079 | Input#1 Low State Name | ASCII | 16 char | | | 8 |
| 7D4F - 7D56 | 32080 - 32087 | Input#1 High State Name | ASCII | 16 char | | | 8 |
| 7D57 - 7D6E | 32088 - 32111 | Input#2 Label and State Names | same as Input#1 | | | | 24 |
| 7D6F - 7D86 | 32112 - 32135 | Input#3 Label and State Names | same as Input#1 | | | | 24 |
| 7D87 - 7D9E | 32136 - 32159 | Input#4 Label and State Names | same as Input#1 | | | | 24 |
| 7D9F - 7DA6 | 32160 - 32167 | Output#1 Label | ASCII | 16 char | | | 8 |
| 7DA7 - 7DAE | 32168 - 32175 | Output#1 Open State Name | ASCII | 16 char | | | 8 |
| 7DAF - 7DB6 | 32176 - 32183 | Output#1 Closed State Name | ASCII | 16 char | | | 8 |
| 7DB7 - 7DCE | 32184 - 32207 | Output#2 Label and State Names | same as Output#1 | | | | 24 |
| 7DCF - 7DE6 | 32208 - 32231 | Output#3 Label and State Names | same as Output#1 | | | | 24 |
| 7DE7 - 7DFE | 32232 - 32255 | Output#4 Label and State Names | same as Output#1 | | | | 24 |
| 7DFF - 7E06 | 32256 - 32263 | Input#1 Accumulator Label | ASCII | 16 char | | | 8 |
| 7E07 - 7E0E | 32264 - 32271 | Input#2 Accumulator Label | ASCII | 16 char | | | 8 |
| 7E0F - 7E16 | 32272 - 32279 | Input#3 Accumulator Label | ASCII | 16 char | | | 8 |
| 7E17 - 7E1E | 32280 - 32287 | Input#4 Accumulator Label | ASCII | 16 char | | | 8 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| 7E1F - 7E1F | 32288 - 32288 | Input#1 Accumulator Kt | UINT16 | bit-mapped | ddVVVVVV VVVVVVVV | KT power factor for the accumulator input "V" is raw power value in Wh/pulse from 0 to 9999. "dd"=decimal point position: 00=0.XXXX, 01=X.XXX, 10=XX.XX, 11= X.XXX. | 1 |
| 7E20 - 7E20 | 32289 - 32289 | Input#2 Accumulator Kt | UINT16 | bit-mapped | ddVVVVVV VVVVVVVV | | 1 |
| 7E21 - 7E21 | 32290 - 32290 | Input#3 Accumulator Kt | UINT16 | bit-mapped | ddVVVVVV VVVVVVVV | | 1 |
| 7E22 - 7E22 | 32291 - 32291 | Input#4 Accumulator Kt | UINT16 | bit-mapped | ddVVVVVV VVVVVVVV | | 1 |
| 7E23 - 7F3E | 32292 - 32575 | Reserved | | | | Reserved | 284 |
| | | | | | | Block Size: | 512 |
| | | | | | | | |
| **Settings Registers for Analog Out 0-1mA / Analog Out 4-20mA Cards** | | | | | **Second Overlay** | **write only in PS update mode** | |
| 7D3F - 7D3F | 32064 - 32064 | Update rate | UINT16 | 0 to 65535 | milliseconds | Fixed -- see specifications. | 1 |
| 7D40 - 7D40 | 32065 - 32065 | Channel direction - 1mA Card only! | UINT16 | bit-mapped | -------- ----4321 | Full range output for 0-1mA card only: A bit set(1) means full range (-1mA to +1mA); a bit cleared(0) means source only (0mA to +1mA). | 1 |
| 7D41 - 7D41 | 32066 - 32066 | Format parameter for output #1 | UINT16 | bit-mapped | -------- ---f suwb | Format of the polled register:f=float 32; s=signed 32 bit int; u=unsigned 32 bit int; w=signed 16 bit int; b=unsigned 16 bit int. | 1 |
| 7D42 - 7D42 | 32067 - 32067 | Source register for Output#1 | UINT16 | 0 to 65535 | | This register should be programmed with the address of the register whose value is to be used for current output. In different words, the current level output of analog board will follow the value of the register addressed here. | 1 |
| 7D43 - 7D44 | 32068 - 32069 | High value of source register for output#1 | Depends on the format parameter | | | Value read from the source register at which High nominal current will be output. Example: for the 4-20mA card, if this register is programmed with 750, then the current output will be 20mA when the value read from the source register is 750. | 2 |
| 7D45 - 7D46 | 32070 - 32071 | Low value of source register for output#1 | Depends on the format parameter | | | Value read from the source register at which Low nominal current will be output. Example: for the 4-20mA card, if this register is programmed with 0, then the current output will be 4mA when the value read from the source register is 0. | 2 |
| 7D47 - 7D4C | 32072 - 32077 | Analog output#2 format, register, max & min | Same as analog output#1 | | | | 6 |
| 7D4D - 7D52 | 32078 - 32083 | Analog output#3 format, register, max & min | Same as analog output#1 | | | | 6 |
| 7D53 - 7D58 | 32084 - 32089 | Analog output#4 format, register, max & min | Same as analog output#1 | | | | 6 |
| 7D59 - 7F3E | 32090 - 32575 | Reserved | | | | Reserved | 486 |
| | | | | | | Block Size: | 512 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| **Settings Registers for Network Cards** | | | | | **Second Overlay** | **write only in PS update mode** | |
| 7D3F - 7D3F | 32064 - 32064 | General Options | | bit-mapped | -----DGT ---- -W-- | W=Web server:0=Enabled, 1=Disabled<br>T=Silentmode:0=Disabled, 1=Enabled<br>(When enabled TCP/Reset is not sent when Connection is attempted to an unbound port)<br>G=Modbus Tcp/Ip Gateway:0=Enabled,1=Disabled<br>D=DNP-Tcp/Ip-Wrapper: 0=Disabled, 1=Enabled. | 1 |
| 7D40 - 7D40 | 32065 - 32065 | DHCP enable | | bit-mapped | -------- -------d | DHCP: d=1 enabled, d=0 disabled (user must provide IP configuration). | 1 |
| 7D41 - 7D48 | 32066 - 32073 | Host name label | ASCII | | | 16 bytes (8 registers) | 8 |
| 7D49 - 7D4C | 32074 - 32077 | IP card network address | UINT16 | 0 to 255 (IPv4) | | These 4 registers hold the 4 numbers (1 number each register) that make the IP address used by the card. | 4 |
| 7D4D - 7D4D | 32078 - 32078 | IP network address mask length | UINT16 | 0 to 32 | | Number of bits that are set in the IP address mask, starting from the Msb of the 32 bit word.<br>Example 24 = 255.255.255.0; a value of 2 would mean 192.0.0.0 | 1 |
| 7D4E - 7D51 | 32079 - 32082 | IP card network gateway address | UINT16 | 0 to 255 (IPv4) | | These 4 registers hold the 4 numbers that make the IP gateway address on network. | 4 |
| 7D52 - 7D55 | 32083 - 32086 | DNS #1, IP address | UINT16 | 0 to 255 (IPv4) | | IP address of the DNS#1 on the network. | 4 |
| 7D56 - 7D59 | 32087 - 32090 | DNS #2, IP address | UINT16 | 0 to 255 (IPv4) | | IP address of the DNS#2 on the network. | 4 |
| 7D5A - 7D5A | 32091 - 32091 | TCP/IP Port – Modbus Gateway Service | UINT16 | 32-65534 | | Port for the Gateway service (modbus tcp/ip) when enabled | 1 |
| 7D5B - 7D5B | 32092 - 32092 | TCP/IP Port – WebService | UINT16 | 32-65534 | | Port for the Web service (html viewer) when enabled | 1 |
| 7D5C - 7D5C | 32093 - 32093 | Reserved – must be set to 0 | | | | Reserved. Set these regs to zero. | 1 |
| 7D5D - 7D5D | 32094 - 32094 | Reserved – must be set to 0 | | | | Reserved. Set these regs to zero. | 1 |
| 7D5E - 7D61 | 32095 - 32098 | Reserved – must be set to 0 | | | | Reserved. Set these regs to zero. | 4 |
| 7D62 - 7D65 | 32099 - 32102 | Reserved – must be set to 0 | | | | Reserved. Set these regs to zero. | 4 |
| 7D66 - 7D66 | 32103 - 32103 | Reserved – must be set to 0 | | | | Reserved. Set these regs to zero. | 1 |
| 7D67 - 7D67 | 32104 - 32104 | Reserved – must be set to 0 | | | | Reserved. Set these regs to zero. | 1 |
| 7D68 - 7D6C | 32105 - 32109 | Reserved – must be set to 0 | | | | Reserved. Set these regs to zero. | 5 |
| 7D6D - 7D8C | 32110 - 32141 | NTP1 URL or IP(string) | | | | IP address of the NTP server the Shark will contact. | 32 |
| 7D8D - 7DAC | 32142 - 32173 | Reserved – must be set to 0 | | | | Set these to regs to zero. Shark uses only 1 NTP | 32 |
| 7DAD - 7F3E | 32174 - 32575 | Reserved – must be set to 0 | | | | Reserved. Set these regs to zero. | 402 |
| | | | | | | Block Size: | 512 |
| ***Programmable Settings for Option Card 2*** | | | | | | | |
| **Option Card 2 Setups Block** | | | | | | **write only in PS update mode** | |
| 80E7 - 80E7 | 33000 - 33000 | Class ID of the Option Card 2 Settings | UINT16 | bit-mapped | -------- ccccttttt | Which class (cccc) and type(tttt) of card the Option Settings for Card 2 apply to. See note 22 | 1 |
| 80E8 - 8126 | 33001 - 33063 | Settings for Option Card 2, First Overlay -- see below | Register assignments depend on which type of card is in the slot. See overlays below. | | | | 63 |
| 8127 - 8326 | 33064 - 33575 | Settings for Option Card 2, Second Overlay -- see below | Register assignments depend on which type of card is in the slot. See overlays below. | | | | 512 |
| | | | | | | Block Size: | 576 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| ***Overlays for Option Card 2 Programmable Settings*** | | | | | | | |
| **Settings Registers for any communication capable card, including network and analog cards** | | | | | **First Overlay** | **write only in PS update mode** | |
| 80E8 - 80E8 | 33001 - 33001 | Slave address | UINT16 | 1~247 (for Modbus)<br>1~65534 (for DNP) | none | Slave address of the unit. The communication capable card is always a master.<br>Set to 0 when an analog board is installed. | 1 |
| 80E9 - 80E9 | 33002 - 33002 | Speed and format | UINT16 | bit-mapped | -abcde-- fghijklm | Bps: a=57600; b=38400; c=19200; d=14400; e=9600<br>Stop bits 'f': cleared 1 stop bit, set 2 stop bits<br>Parity: g=even; h=odd; i=none<br>Data bits: j=8; k=7; l=6; m=5<br>Set to 0 when an analog board is installed. | 1 |
| 80EA - 80EA | 33003 - 33003 | Reserved | UINT16 | bit-mapped | | Reserved | 1 |
| 80EB - 80EB | 33004 - 33004 | Protocol | UINT16 | bit-mapped | -------- -----ppp- | ppp= 100 =DNP3; 010=Ascii Modbus; 001=Rtu Modbus<br>Set to 0 when an analog board is installed. | 1 |
| 80EC - 80EC | 33005 - 33005 | Reply delay | UINT16 | 0 to 65535 | milliseconds | Delay to reply to a Modbus transaction after receiving it.<br>Set to 0 when an analog board is installed | 1 |
| 80ED - 8126 | 33006 - 33063 | Reserved | | | | Reserved | 58 |
| | | | | | | Block Size: | 63 |
| **Settings Registers for Digital I/O Relay Card** | | | | | **First Overlay** | **write only in PS update mode** | |
| 80E8 - 80E8 | 33001 - 33001 | Input#1 - 2 bindings & logging enables | UINT16 | bit-mapped | -------- 2222 1111 | One nibble for each input.<br>Assuming "abcc" as the bits in each nibble:<br>"a": select this input for EOI (End Of Interval)pulse sensing.<br>"b": log this input when pulse is detected<br>"cc": Input event trigger mode - Contact sensing method; 00 = none; 01 = open to close; 10 = close to open; 11 = any change.<br>Every input has an associated internal accumulator (See input Accumulator Scaling), which is incremented every time the input changes according with the trigger mode crieteria "cc" | 1 |
| 80E9 - 80E9 | 33002 - 33002 | Relay #1 Delay to Operate | UINT16 | 0.1 second units | | Delay to operate the relay since request. | 1 |
| 80EA - 80EA | 33003 - 33003 | Relay #1 Delay to Release | UINT16 | 0.1 second units | | Delay to release the relay since request. | 1 |
| 80EB - 80F0 | 33004 - 33009 | Reserved | UINT16 | | | Set to 0. | 6 |
| 80F1 - 80F1 | 33010 - 33010 | Relay #2 Delay to Operate | UINT16 | 0.1 second units | | Delay to operate the relay since request. | 1 |
| 80F2 - 80F2 | 33011 - 33011 | Relay #2 Delay to Release | UINT16 | 0.1 second units | | Delay to release the relay since request. | 1 |
| 80F3 - 8108 | 33012 - 33033 | Reserved | UINT16 | | | Set to 0. | 22 |
| 8109 - 8109 | 33034 - 33034 | Input Accumulators Scaling | UINT16 | bit-mapped | -------- 22221111 | 4 bits per input or output accumulator | 1 |
| 810A - 810A | 33035 - 33035 | Relay Accumulators Scaling | UINT16 | bit-mapped | -------- 22221111 | The nibble informs what should be the scaling of the accumulator 0=no-scaling, 1=0.1, 2=0.01, 3= 1m, 4=0.1m, 5=0.01m, 6=1u, 7=0.1u; the value 15 disable the accumulator.<br>Example: suppose that the internal input accumulator #1 is 12345, and its corresponding scaling setting is "0011" (3 decimal). Then, the accumulator will be read as: Scaling 3, means 1m or 0.001.<br>Scaled accumulator = 12345 * 0.001 = 12 (Twelve). | 1 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| 810B - 810B | 33036 - 33036 | Fast pulse input selector | UINT16 | bit-mapped | p------- -----nnn | When value 'nnn' is non-zero, it determines which of the card inputs will be a fast pulse detection input. The polarity bit 'P' tells the event to be detected: 1=open-to-close; 0=close-to-open. There is no “any-change” detection mode. | 1 |
| 810C - 8126 | 33037 - 33063 | Reserved | | | | Reserved | 27 |
| | | | | | | Block Size: | 63 |
| **Settings Registers for Digital I/O Pulse Output Card** | | | | | **First Overlay** | **write only in PS update mode** | |
| 80E8 - 80E8 | 33001 - 33001 | Input#1 - 4 bindings & logging enables | UINT16 | bit-mapped | 44443333 22221111 | One nibble for each input. Assuming "abcc" as the bits in each nibble: "a": select this input for EOI (End Of Interval)pulse sensing. "b": log this input when pulse is detected "cc": Input event trigger mode - Contact sensing method; 00 = none; 01 = open to close; 10 = close to open; 11 = any change. Every input has an associated internal accumulator (See input Accumulator Scaling), which is incremented every time the input changes according with the trigger mode crieteria “cc” | 1 |
| 80E9 - 80E9 | 33002 - 33002 | Source for Pulse Ouput#1 | UINT16 | enumeration | -----ppp ----vvvv | "ppp" (Phase) : 000 = none, 001 = Phase A, 010 = Phase B, 011 = Phase C, 100 = All Phases, 101 = Pulse from EOI(End Of Interval). "vvvv"(Value) : 0000= none, 0001 = Wh, 0010 = +Wh, 0011 = -Wh, 0100= Varh, 0101 = +Varh, 0110 = -Varh, 0111 = VAh, 1000= Received Wh, 1001= Delivered Wh, 1010= Inductive Varh, 1011 = Capacitive Varh | 1 |
| 80EA - 80EA | 33003 - 33003 | Kt [Wh/pulse] factor for Pulse Output#1 | UINT16 | bit-mapped | ddVVVVVV VVVVVVVV | "V…V" = not scaled energy value per pulse, from 0 to 9999. "dd"= decimal point position: 00=0.XXXX, 01=X.XXX, 10=XX.XX, 11= X.XXX. | 1 |
| 80EB - 80EC | 33004 - 33005 | Output#2 Assignment and Kt | UINT16 | same as Output #1 | | | 2 |
| 80ED - 80EE | 33006 - 33007 | Output#3 Assignment and Kt | UINT16 | same as Output #1 | | | 2 |
| 80EF - 80F0 | 33008 - 33009 | Output#4 Assignment and Kt | UINT16 | same as Output #1 | | | 2 |
| 80F1 - 80F1 | 33010 - 33010 | Input Accumulators Scaling | UINT16 | bit-mapped | 44443333 22221111 | see Relay Card above | 1 |
| 80F2 - 80F2 | 33011 - 33011 | Output Accumulators Scaling | UINT16 | bit-mapped | 44443333 22221111 | | 1 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 80F3 - 80F3 | 33012 - 33012 | Fast pulse input selector | UINT16 | bit-mapped | p------- -----nnn | When value 'nnn' is non-zero, it determines which of the card inputs will be a fast pulse detection input. The polarity bit 'P' tells the event to be detected: 1=open-to-close; 0=close-to-open. There is no “any-change” detection mode. | 1 |
| 80F4 - 8126 | 33013 - 33063 | Reserved | | | | Reserved | 51 |
| | | | | | | Block Size: | 63 |
| **Settings Registers for Digital I/O Relay Card** | | | | | **Second Overlay** | **write only in PS update mode** | |
| 8127 - 812E | 33064 - 33071 | Input#1 Label | ASCII | 16 char | | | 8 |
| 812F - 8136 | 33072 - 33079 | Input#1 Low State Name | ASCII | 16 char | | | 8 |
| 8137 - 813E | 33080 - 33087 | Input#1 High State Name | ASCII | 16 char | | | 8 |
| 813F - 8156 | 33088 - 33111 | Input#2 Label and State Names | same as Input#1 | | | | 24 |
| 8157 - 8186 | 33112 - 33159 | Reserved | | | | | 48 |
| 8187 - 818E | 33160 - 33167 | Relay#1 Label | ASCII | 16 char | | | 8 |
| 818F - 8196 | 33168 - 33175 | Relay#1 Open State Name | ASCII | 16 char | | | 8 |
| 8197 - 819E | 33176 - 33183 | Relay#1 Closed State Name | ASCII | 16 char | | | 8 |
| 819F - 81B6 | 33184 - 33207 | Relay#2 Label and State Names | same as Relay#1 | | | | 24 |
| 81B7 - 81E6 | 33208 - 33255 | Reserved | | | | | 48 |
| 81E7 - 81EE | 33256 - 33263 | Input#1 Accumulator Label | ASCII | 16 char | | | 8 |
| 81EF - 81F6 | 33264 - 33271 | Input#2 Accumulator Label | ASCII | 16 char | | | 8 |
| 8208 - 8208 | 33289 - 33289 | Input#2 Accumulator Kt | UINT16 | bit-mapped | ddVVVVVV VVVVVVVV | KT power factor for the Pulse Output "V" is raw power value in Wh/pulse from 0 to 9999. "dd"=decimal point position: 00=0.XXXX, 01=X.XXX, 10=XX.XX, 11= X.XXX. | 1 |
| 8209 - 8326 | 33290 - 33575 | Reserved | | | | | 286 |
| | | | | | | Block Size: | 512 |
| **Settings Registers for Digital I/O Pulse Output Card** | | | | | **Second Overlay** | **write only in PS update mode** | |
| 8127 - 812E | 33064 - 33071 | Input#1 Label | ASCII | 16 char | | | 8 |
| 812F - 8136 | 33072 - 33079 | Input#1 Low State Name | ASCII | 16 char | | | 8 |
| 8137 - 813E | 33080 - 33087 | Input#1 High State Name | ASCII | 16 char | | | 8 |
| 813F - 8156 | 33088 - 33111 | Input#2 Label and State Names | same as Input#1 | | | | 24 |
| 8157 - 816E | 33112 - 33135 | Input#3 Label and State Names | same as Input#1 | | | | 24 |
| 816F - 8186 | 33136 - 33159 | Input#4 Label and State Names | same as Input#1 | | | | 24 |
| 8187 - 818E | 33160 - 33167 | Output#1 Label | ASCII | 16 char | | | 8 |
| 818F - 8196 | 33168 - 33175 | Output#1 Open State Name | ASCII | 16 char | | | 8 |
| 8197 - 819E | 33176 - 33183 | Output#1 Closed State Name | ASCII | 16 char | | | 8 |
| 819F - 81B6 | 33184 - 33207 | Output#2 Label and State Names | same as Output#1 | | | | 24 |
| 81B7 - 81CE | 33208 - 33231 | Output#3 Label and State Names | same as Output#1 | | | | 24 |
| 81CF - 81E6 | 33232 - 33255 | Output#4 Label and State Names | same as Output#1 | | | | 24 |
| 81E7 - 81EE | 33256 - 33263 | Input#1 Accumulator Label | ASCII | 16 char | | | 8 |
| 81EF - 81F6 | 33264 - 33271 | Input#2 Accumulator Label | ASCII | 16 char | | | 8 |
| 81F7 - 81FE | 33272 - 33279 | Input#3 Accumulator Label | ASCII | 16 char | | | 8 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 81FF - 8206 | 33280 - 33287 | Input#4 Accumulator Label | ASCII | 16 char | | | 8 |
| 8207 - 8207 | 33288 - 33288 | Input#1 Accumulator Kt | UINT16 | bit-mapped | ddVVVVVV VVVVVVVV | KT power factor for the accumulator input "V" is raw power value in Wh/pulse from 0 to 9999. "dd"=decimal point position: 00=0.XXXX, 01=X.XXX, 10=XX.XX, 11= X.XXX. | 1 |
| 8208 - 8208 | 33289 - 33289 | Input#2 Accumulator Kt | UINT16 | bit-mapped | ddVVVVVV VVVVVVVV | | 1 |
| 8209 - 8209 | 33290 - 33290 | Input#3 Accumulator Kt | UINT16 | bit-mapped | ddVVVVVV VVVVVVVV | | 1 |
| 820A - 820A | 33291 - 33291 | Input#4 Accumulator Kt | UINT16 | bit-mapped | ddVVVVVV VVVVVVVV | | 1 |
| 820B - 8326 | 33292 - 33575 | Reserved | | | | Reserved | 284 |
| | | | | | | Block Size: | 512 |
| **Settings Registers for Analog Out 0-1mA / Analog Out 4-20mA Cards** | | | | | **Second Overlay** | **write only in PS update mode** | |
| 8127 - 8127 | 33064 - 33064 | Update rate | UINT16 | 0 to 65535 | milliseconds | Fixed -- see specifications. | 1 |
| 8128 - 8128 | 33065 - 33065 | Channel direction - 1mA Card only! | UINT16 | bit-mapped | -------- ----4321 | Full range output for 0-1mA card only: A bit set(1) means full range (-1mA to +1mA); a bit cleared(0) means source only (0mA to +1mA). | 1 |
| 8129 - 8129 | 33066 - 33066 | Format parameter for output #1 | UINT16 | bit-mapped | -------- ---f suwb | Format of the polled register:f=float 32; s=signed 32 bit int; u=unsigned 32 bit int; w=signed 16 bit int; b=unsigned 16 bit int. | 1 |
| 812A - 812A | 33067 - 33067 | Source register for Output#1 | UINT16 | 0 to 65535 | | This register should be programmed with the address of the register whose value is to be used for current output. In different words, the current level output of analog board will follow the value of the register addressed here. | 1 |
| 812B - 812C | 33068 - 33069 | High value of source register for output#1 | Depends on the format parameter | | | Value read from the source register at which High nominal current will be output. Example: for the 4-20mA card, if this register is programmed with 750, then the current output will be 20mA when the value read from the source register is 750. | 2 |
| 812D - 812E | 33070 - 33071 | Low value of source register for output#1 | Depends on the format parameter | | | Value read from the source register at which Low nominal current will be output. Example: for the 4-20mA card, if this register is programmed with 0, then the current output will be 4mA when the value read from the source register is 0. | 2 |
| 812F - 8134 | 33072 - 33077 | Analog output#2 format, register, max & min | Same as analog output#1 | | | | 6 |
| 8135 - 813A | 33078 - 33083 | Analog output#3 format, register, max & min | Same as analog output#1 | | | | 6 |
| 813B - 8140 | 33084 - 33089 | Analog output#4 format, register, max & min | Same as analog output#1 | | | | 6 |
| 8141 - 8326 | 33090 - 33575 | Reserved | | | | Reserved | 486 |
| | | | | | | Block Size: | 512 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| **Settings Registers for Network Cards** | | | | | **Second Overlay** | **write only in PS update mode** | |
| 8127 - 8127 | 33064 - 33064 | General Options | | bit-mapped | -----DGT ---- -W-- | W=Web server:0=Enabled, 1=Disabled<br>T=Silentmode:0=Disabled, 1=Enabled<br>(When enabled TCP/Reset is not sent when Connection is attempted to an unbound port)<br>G=Modbus Tcp/Ip Gateway:0=Enabled,1=Disabled<br>D=DNP-Tcp/Ip-Wrapper: 0=Disabled, 1=Enabled. | 1 |
| 8128 - 8128 | 33065 - 33065 | DHCP enable | | bit-mapped | -------- -------d | DHCP: d=1 enabled, d=0 disabled (user must provide IP configuration). | 1 |
| 8129 - 8130 | 33066 - 33073 | Host name label | ASCII | | | 16 bytes (8 registers) | 8 |
| 8131 - 8134 | 33074 - 33077 | IP card network address | UINT16 | 0 to 255 (IPv4) | | These 4 registers hold the 4 numbers (1 number each register) that make the IP address used by the card. | 4 |
| 8135 - 8135 | 33078 - 33078 | IP network address mask length | UINT16 | 0 to 32 | | Number of bits that are set in the IP address mask, starting from the Msb of the 32 bit word.<br>Example 24 = 255.255.255.0; a value of 2 would mean 192.0.0.0 | 1 |
| 8136 - 8139 | 33079 - 33082 | IP card network gateway address | UINT16 | 0 to 255 (IPv4) | | These 4 registers hold the 4 numbers that make the IP gateway address on network. | 4 |
| 813A - 813D | 33083 - 33086 | DNS #1, IP address | UINT16 | 0 to 255 (IPv4) | | IP address of the DNS#1 on the network. | 4 |
| 813E - 8141 | 33087 - 33090 | DNS #2, IP address | UINT16 | 0 to 255 (IPv4) | | IP address of the DNS#2 on the network. | 4 |
| 8142 - 8142 | 33091 - 33091 | TCP/IP Port – Modbus Gateway Service | UINT16 | 32-65534 | | Port for the Gateway service (modbus tcp/ip) when enabled | 1 |
| 8143 - 8143 | 33092 - 33092 | TCP/IP Port – WebService | UINT16 | 32-65534 | | Port for the Web service (html viewer) when enabled | 1 |
| 8144 - 8144 | 33093 - 33093 | Reserved – must be set to 0 | | | | Reserved. Set these regs to zero. | 1 |
| 8145 - 8145 | 33094 - 33094 | Reserved – must be set to 0 | | | | Reserved. Set these regs to zero. | 1 |
| 8146 - 8149 | 33095 - 33098 | Reserved – must be set to 0 | | | | Reserved. Set these regs to zero. | 4 |
| 814A - 814D | 33099 - 33102 | Reserved – must be set to 0 | | | | Reserved. Set these regs to zero. | 4 |
| 814E - 814E | 33103 - 33103 | Reserved – must be set to 0 | | | | Reserved. Set these regs to zero. | 1 |
| 814F - 814F | 33104 - 33104 | Reserved – must be set to 0 | | | | Reserved. Set these regs to zero. | 1 |
| 8150 - 8154 | 33105 - 33109 | Reserved – must be set to 0 | | | | Reserved. Set these regs to zero. | 5 |
| 8155 - 8174 | 33110 - 33141 | NTP1 URL or IP(string) | | | | IP address of the NTP server the Shark will contact. | 32 |
| 8175 - 8194 | 33142 - 33173 | Reserved – must be set to 0 | | | | Set these to regs to zero. Shark uses only 1 NTP | 32 |
| 8195 - 8326 | 33174 - 33575 | Reserved – must be set to 0 | | | | Reserved. Set these regs to zero. | 402 |
| | | | | | | Block Size: | 512 |
| | | | | | | | |
| | | ***Secondary Readings Sectior*** | | | | | |
| **Secondary Block** | | | | | | **read-only except as noted** | |
| 9C40 - 9C40 | 40001 - 40001 | System Sanity Indicator | UINT16 | 0 or 1 | none | 0 indicates proper meter operation | 1 |
| 9C41 - 9C41 | 40002 - 40002 | Volts A-N | UINT16 | 2047 to 4095 | volts | 2047= 0, 4095= +150 | 1 |
| 9C42 - 9C42 | 40003 - 40003 | Volts B-N | UINT16 | 2047 to 4095 | volts | volts = 150 * (register - 2047) / 2047 | 1 |
| 9C43 - 9C43 | 40004 - 40004 | Volts C-N | UINT16 | 2047 to 4095 | volts | | 1 |
| 9C44 - 9C44 | 40005 - 40005 | Amps A | UINT16 | 0 to 4095 | amps | 0= -10, 2047= 0, 4095= +10 | 1 |
| 9C45 - 9C45 | 40006 - 40006 | Amps B | UINT16 | 0 to 4095 | amps | amps = 10 * (register - 2047) / 2047 | 1 |
| 9C46 - 9C46 | 40007 - 40007 | Amps C | UINT16 | 0 to 4095 | amps | | 1 |
| 9C47 - 9C47 | 40008 - 40008 | Watts, 3-Ph total | UINT16 | 0 to 4095 | watts | 0= -3000, 2047= 0, 4095= +3000 | 1 |
| 9C48 - 9C48 | 40009 - 40009 | VARs, 3-Ph total | UINT16 | 0 to 4095 | VARs | watts, VARs, VAs = | 1 |
| 9C49 - 9C49 | 40010 - 40010 | VAs, 3-Ph total | UINT16 | 2047 to 4095 | VAs | 3000 * (register - 2047) / 2047 | 1 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 9C4A - 9C4A | 40011 - 40011 | Power Factor, 3-Ph total | UINT16 | 1047 to 3047 | none | 1047= -1, 2047= 0, 3047= +1<br>pf = (register - 2047) / 1000 | 1 |
| 9C4B - 9C4B | 40012 - 40012 | Frequency | UINT16 | 0 to 2730 | Hz | 0= 45 or less, 2047= 60, 2730= 65 or more<br>freq = 45 + ((register / 4095) * 30) | 1 |
| 9C4C - 9C4C | 40013 - 40013 | Volts A-B | UINT16 | 2047 to 4095 | volts | 2047= 0, 4095= +300 | 1 |
| 9C4D - 9C4D | 40014 - 40014 | Volts B-C | UINT16 | 2047 to 4095 | volts | volts = 300 * (register - 2047) / 2047 | 1 |
| 9C4E - 9C4E | 40015 - 40015 | Volts C-A | UINT16 | 2047 to 4095 | volts | | 1 |
| 9C4F - 9C4F | 40016 - 40016 | CT numerator | UINT16 | 1 to 9999 | none | CT = numerator * multiplier / denominator | 1 |
| 9C50 - 9C50 | 40017 - 40017 | CT multiplier | UINT16 | 1, 10, 100 | none | | 1 |
| 9C51 - 9C51 | 40018 - 40018 | CT denominator | UINT16 | 1 or 5 | none | | 1 |
| 9C52 - 9C52 | 40019 - 40019 | PT numerator | UINT16 | 1 to 9999 | none | PT = numerator * multiplier / denominator | 1 |
| 9C53 - 9C53 | 40020 - 40020 | PT multiplier | UINT16 | 1, 10, 100, 1000 | none | | 1 |
| 9C54 - 9C54 | 40021 - 40021 | PT denominator | UINT16 | 1 to 9999 | none | | 1 |
| 9C55 - 9C56 | 40022 - 40023 | W-hours, Positive | UINT32 | 0 to 99999999 | Wh per energy format | * 5 to 8 digits | 2 |
| 9C57 - 9C58 | 40024 - 40025 | W-hours, Negative | UINT32 | 0 to 99999999 | Wh per energy format | * decimal point implied, per energy format | 2 |
| 9C59 - 9C5A | 40026 - 40027 | VAR-hours, Positive | UINT32 | 0 to 99999999 | VARh per energy format | * resolution of digit before decimal point = units, kilo, or | 2 |
| 9C5B - 9C5C | 40028 - 40029 | VAR-hours, Negative | UINT32 | 0 to 99999999 | VARh per energy format | mega, per energy format | 2 |
| 9C5D - 9C5E | 40030 - 40031 | VA-hours | UINT32 | 0 to 99999999 | VAh per energy format | * see note 10 | 2 |
| 9C5F - 9C60 | 40032 - 40033 | W-hours, Positive, Phase A | UINT32 | 0 to 99999999 | Wh per energy format | | 2 |
| 9C61 - 9C62 | 40034 - 40035 | W-hours, Positive, Phase B | UINT32 | 0 to 99999999 | Wh per energy format | | 2 |
| 9C63 - 9C64 | 40036 - 40037 | W-hours, Positive, Phase C | UINT32 | 0 to 99999999 | Wh per energy format | | 2 |
| 9C65 - 9C66 | 40038 - 40039 | W-hours, Negative, Phase A | UINT32 | 0 to 99999999 | Wh per energy format | | 2 |
| 9C67 - 9C68 | 40040 - 40041 | W-hours, Negative, Phase B | UINT32 | 0 to 99999999 | Wh per energy format | | 2 |
| 9C69 - 9C6A | 40042 - 40043 | W-hours, Negative, Phase C | UINT32 | 0 to 99999999 | Wh per energy format | | 2 |
| 9C6B - 9C6C | 40044 - 40045 | VAR-hours, Positive, Phase A | UINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 9C6D - 9C6E | 40046 - 40047 | VAR-hours, Positive, Phase B | UINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 9C6F - 9C70 | 40048 - 40049 | VAR-hours, Positive, Phase C | UINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 9C71 - 9C72 | 40050 - 40051 | VAR-hours, Negative, Phase A | UINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 9C73 - 9C74 | 40052 - 40053 | VAR-hours, Negative, Phase B | UINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 9C75 - 9C76 | 40054 - 40055 | VAR-hours, Negative, Phase C | UINT32 | 0 to 99999999 | VARh per energy format | | 2 |
| 9C77 - 9C78 | 40056 - 40057 | VA-hours, Phase A | UINT32 | 0 to 99999999 | VAh per energy format | | 2 |
| 9C79 - 9C7A | 40058 - 40059 | VA-hours, Phase B | UINT32 | 0 to 99999999 | VAh per energy format | | 2 |
| 9C7B - 9C7C | 40060 - 40061 | VA-hours, Phase C | UINT32 | 0 to 99999999 | VAh per energy format | | 2 |
| 9C7D - 9C7D | 40062 - 40062 | Watts, Phase A | UINT16 | 0 to 4095 | watts | | 1 |
| 9C7E - 9C7E | 40063 - 40063 | Watts, Phase B | UINT16 | 0 to 4095 | watts | | 1 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| 9C7F - 9C7F | 40064 - 40064 | Watts, Phase C | UINT16 | 0 to 4095 | watts | | 1 |
| 9C80 - 9C80 | 40065 - 40065 | VARs, Phase A | UINT16 | 0 to 4095 | VARs | 0= -3000, 2047= 0, 4095= +3000 | 1 |
| 9C81 - 9C81 | 40066 - 40066 | VARs, Phase B | UINT16 | 0 to 4095 | VARs | watts, VARs, VAs = | 1 |
| 9C82 - 9C82 | 40067 - 40067 | VARs, Phase C | UINT16 | 0 to 4095 | VARs | 3000 * (register - 2047) / 2047 | 1 |
| 9C83 - 9C83 | 40068 - 40068 | VAs, Phase A | UINT16 | 2047 to 4095 | VAs | | 1 |
| 9C84 - 9C84 | 40069 - 40069 | VAs, Phase B | UINT16 | 2047 to 4095 | VAs | | 1 |
| 9C85 - 9C85 | 40070 - 40070 | VAs, Phase C | UINT16 | 2047 to 4095 | VAs | | 1 |
| 9C86 - 9C86 | 40071 - 40071 | Power Factor, Phase A | UINT16 | 1047 to 3047 | none | 1047= -1, 2047= 0, 3047= +1 | 1 |
| 9C87 - 9C87 | 40072 - 40072 | Power Factor, Phase B | UINT16 | 1047 to 3047 | none | pf = (register - 2047) / 1000 | 1 |
| 9C88 - 9C88 | 40073 - 40073 | Power Factor, Phase C | UINT16 | 1047 to 3047 | none | | 1 |
| 9C89 - 9CA2 | 40074 - 40099 | Reserved | N/A | N/A | none | Reserved | 26 |
| 9CA3 - 9CA3 | 40100 - 40100 | Reset Energy Accumulators | UINT16 | password (Note 5) | | write-only register; always reads as 0 | 1 |
| | | | | | | Block Size: | 100 |
| | | | | | | | |
| | | ***Log Retrieval Section*** | | | | | |
| **Log Retrieval Block** | | | | | | **read/write except as noted** | |
| C34C - C34D | 49997 - 49998 | Log Retrieval Session Duration | UINT32 | 0 to 4294967294 | 4 msec | 0 if no session active; wraps around after max count | 2 |
| C34E - C34E | 49999 - 49999 | Log Retrieval Session Com Port | UINT16 | 0 to 4 | | 0 if no session active, 1-4 for session active on COM1 - COM4 | 1 |
| C34F - C34F | 50000 - 50000 | Log Number, Enable, Scope | UINT16 | bit-mapped | nnnnnnnn essssss | high byte is the log number (0-system, 1-alarm, 2-history1, 3-history2, 4-history3, 5-I/O changes, 10-PQ, 11-waveform<br>e is retrieval session enable(1) or disable(0)<br>ssssss is what to retrieve (0-normal record, 1-timestamps only, 2-complete memory image (no data validation if image) | 1 |
| C350 - C350 | 50001 - 50001 | Records per Window or Batch, Record Scope Selector, Number of Repeats | UINT16 | bit-mapped | wwwwwwww snnnnnnn | high byte is records per window if s=0 or records per batch if s=1, low byte is number of repeats for function 35 or 0 to suppress auto-incrementing; max number of repeats is 8 (RTU) or 4 (ASCII) total windows, a batch is all the windows | 1 |
| C351 - C352 | 50002 - 50003 | Offset of First Record in Window | UINT32 | bit-mapped | ssssssss nnnnnnnn nnnnnnnn nnnnnnnn | ssssssss is window status (0 to 7-window number, 0xFF-not ready); this byte is read-only.<br>nn…nn is a 24-bit record number. The log's first record is latched as a reference point when the session is enabled. This offset is a record index relative to that point. Value provided is the relative index of the whole or partial record that begins the window. | 2 |
| C353 - C3CD | 50004 - 50126 | Log Retrieve Window | UINT16 | see comments | none | mapped per record layout and retrieval scope, read-only | 123 |
| | | | | | | Block Size: | 130 |

| Modbus Address Hex | Modbus Address Decimal | Description (Note 1) | Format | Range (Note 6) | Units or Resolution | Comments | # Reg |
|---|---|---|---|---|---|---|---|
| **Log Status Block** | | | | | | **read only** | |
| | | **Alarm Log Status Block** | | | | | |
| C737 - C738 | 51000 - 51001 | Log Size in Records | UINT32 | 0 to 4,294,967,294 | record | | 2 |
| C739 - C73A | 51002 - 51003 | Number of Records Used | UINT32 | 1 to 4,294,967,294 | record | | 2 |
| C73B - C73B | 51004 - 51004 | Record Size in Bytes | UINT16 | 14 to 242 | byte | | 1 |
| C73C - C73C | 51005 - 51005 | Log Availability | UINT16 | | none | 0=available,<br>1-4=in use by COM1-4,<br>0xFFFF=not available (log size=0) | 1 |
| C73D - C73F | 51006 - 51008 | Timestamp, First Record | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| C740 - C742 | 51009 - 51011 | Timestamp, Last Record | TSTAMP | 1Jan2000 - 31Dec2099 | 1 sec | | 3 |
| C743 - C746 | 51012 - 51015 | Reserved | | | | Reserved | 4 |
| | | | | | | Individual Log Status Block Size: | 16 |
| C747 - C756 | 51016 - 51031 | **System Log Status Block** | | same as alarm log status block | | | 16 |
| C757 - C766 | 51032 - 51047 | **Historical Log 1 Status Block** | | same as alarm log status block | | | 16 |
| C767 - C776 | 51048 - 51063 | **Historical Log 2 Status Block** | | same as alarm log status block | | | 16 |
| C777 - C786 | 51064 - 51079 | **Historical Log 3 Status Block** | | same as alarm log status block | | | 16 |
| C787 - C796 | 51080 - 51095 | **I/O Change Log Status Block** | | same as alarm log status block | | | 16 |
| C797 - C7A6 | 51096 - 51111 | **Power Quality Log Status Block** | | same as alarm log status block | | | 16 |
| C7A7 - C7B6 | 51112 - 51127 | **Waveform Capture Log Status Block** | | same as alarm log status block | | | 16 |
| | | | | | | Block Size: | 128 |
| | | | | | | | |
| | | ***End of Map*** | | | | | |

| **Data Formats** | |
|---|---|
| ASCII | ASCII characters packed 2 per register in high, low order and without any termination characters. For example, "Shark200" would be 4 registers containing 0x5378, 0x6172, 0x6B32, 0x3030. |
| SINT16 / UINT16 | 16-bit signed / unsigned integer. |
| SINT32 / UINT32 | 32-bit signed / unsigned integer spanning 2 registers. The lower-addressed register is the high order half. |
| FLOAT | 32-bit IEEE floating point number spanning 2 registers. The lower-addressed register is the high order half (i.e., contains the exponent). |
| TSTAMP | 3 adjacent registers, 2 bytes each. First (lowest-addressed) register high byte is year (0-99), low byte is month (1-12). Middle register high byte is day(1-31), low byte is hour (0-23 plus DST bit). DST (daylight saving time) bit is bit 6 (0x40). Third register high byte is minutes (0-59), low byte is seconds (0-59). For example, 9:35:07AM on October 12, 2049 would be 0x310A, 0x0C49, 0x2307, assuming DST is in effect. |

| Notes | |
|---|---|
| 1 | All registers not explicitly listed in the table read as 0. Writes to these registers will be accepted but won't actually change the register (since it doesn't exist). |
| 2 | Meter Data Section items read as 0 until first readings are available or if the meter is not in operating mode. Writes to these registers will be accepted but won't actually change the register. |
| 3 | Register valid only in programmable settings update mode. In other modes these registers read as 0 and return an illegal data address exception if a write is attempted. |
| 4 | Meter command registers always read as 0. They may be written only when the meter is in a suitable mode. The registers return an illegal data address exception if a write is attempted in an incorrect mode. |
| 5 | If the password is incorrect, a valid response is returned but the command is not executed. Use 5555 for the password if passwords are disabled in the programmable settings. |
| 6 | M denotes a 1,000,000 multiplier. |
| 7 | Each identifier is a Modbus register. For entities that occupy multiple registers (FLOAT, SINT32, etc.) all registers making up the entity must be listed, in ascending order. For example, to log phase A volts, VAs, voltage THD, and VA hours, the register list would be 0x3E7, 0x3E8, 0x411, 0x412, 0x176F, 0x61D, 0x61E and the number of registers (0x7917 high byte) would be 7. |
| 8 | Writing this register causes data to be saved permanently in nonvolatile memory. Reply to the command indicates that it was accepted but not whether or not the save was successful. This can only be determined after the meter has restarted. |
| 9 | Reset commands make no sense if the meter state is LIMP. An illegal function exception will be returned. |
| 10 | Energy registers should be reset after a format change. |
| 11 | Entities to be monitored against limits are identified by Modbus address. Entities occupying multiple Modbus registers, such as floating point values, are identified by the lower register address. If any of the 8 limits is unused, set its identifier to zero. If the indicated Modbus register is not used or is a nonsensical entity for limits, it will behave as an unused limit. |
| 12 | There are 2 setpoints per limit, one above and one below the expected range of values. LM1 is the "too high" limit, LM2 is "too low". The entity goes "out of limit" on LM1 when its value is greater than the setpoint. It remains "out of limit" until the value drops below the in threshold. LM2 works similarly, in the opposite direction. If limits in only one direction are of interest, set the in threshold on the "wrong" side of the setpoint. Limits are specified as % of full scale, where full scale is automatically set appropriately for the entity being monitored: |

| | |
|---|---|
| current | FS = CT numerator * CT multiplier |
| voltage | FS = PT numerator * PT multiplier |
| 3 phase power | FS = CT numerator * CT multiplier * PT numerator * PT multiplier * 3 [ * SQRT(3) for delta hookup] |
| single phase power | FS = CT numerator * CT multiplier * PT numerator * PT multiplier [ * SQRT(3) for delta hookup] |
| frequency | FS = 60 (or 50) |
| power factor | FS = 1.0 |
| percentage | FS = 100.0 |
| angle | FS = 180.0 |

| | |
|---|---|
| 13 | THD not available shows 10000 in all THD and harmonic magnitude and phase registers for the channel. THD may be unavailable due to low V or I amplitude, delta hookup (V only), or V-switch setting. |
| 14 | Option Card Identification and Configuration Block is an image of the EEPROM on the card |
| 15 | A block of data and control registers is allocated for each option slot. Interpretation of the register data depends on what card is in the slot. |
| 16 | Measurement states: Off occurs during programmable settings updates; Run is the normal measuring state; Limp indicates that an essentail non-volatile memory block is corrupted; and Warmup occurs briefly (approximately 4 seconds) at startup while the readings stabilize. Run state is required for measurement, historical logging, demand interval processing, limit alarm evaluation, min/max comparisons, and THD calculations. Resetting min/max or energy is allowed only in run and off states; warmup will return a busy exception. In limp state, the meter reboots at 5 minute intervals in an effort to clear the problem. |
| 17 | Limits evaluation for all entites except demand averages commences immediately after the warmup period. Evaluation for demand averages, maximum demands, and minimum demands commences at the end of the first demand interval after startup. |
| 18 | Autoincrementing and function 35 must be used when retrieving waveform logs. |
| 19 | Depending on the V-switch setting, there are 15, 29, or 45 flash sectors available in a common pool for distribution among the 3 historical and waveform logs. The pool size, number of sectors for each log, and the number of registers per record together determine the maximum number of records a log can hold. |

S = number of sectors assigned to the log,
H = number of Modbus registers to be monitored in each historical record (up to 117),
R = number of bytes per record = (12 + 2H) for historical logs
N = number of records per sector = 65516 / R, rounded down to an integer value (no partial records in a sector)
T = total number of records the log can hold = S * N
T = S * 2 for the waveform log.

| | |
|---|---|
| 20 | Only 1 input on all digital input cards may be specified as the end-of-interval pulse. |
| 21 | Logs cannot be reset during log retrieval. Waveform log cannot be reset while storing a capture. Busy exception will be returned. |
| 22 | Combination of class and type currently defined are:<br>0x23 = Fiber cards<br>0x24 = Network card<br>0x41 = Relay card<br>0x42 = Pulse card<br>0x81 = 0-1mA analog output card<br>0x82 = 4-20mA analog output card. |

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# C: DNP Mapping

## C.1: Overview

This Appendix describes the functionality of the Shark® 200 meter's version of the DNP protocol. A DNP programmer needs this information to retrieve data from the Shark® 200 meter. The DNP version used by the Shark 200 is a reduced set of the Distributed Network Protocol Version 3.0 subset 2; it gives enough functionality to get critical measurements from the Shark® 200 meter.

The Shark® 200 meter's DNP version supports Class 0 object/qualifiers 0,1,2,6, only. No event generation is supported. The Shark® 200 meter always acts as a secondary device (slave) in DNP communication.

A new feature allows DNP readings in primary units with user-set scaling for current, Voltage, and power (see Chapter 5 in the *Communicator EXT*™ *User Manual* for instructions).

## C.2: Physical Layer

The Shark® 200 meter's DNP version uses serial communication. Port 2 (RS485 compliant port) or any communication capable option board can be used. Speed and data format is transparent for the Shark® 200 meter's DNP version: they can be set to any supported value. The IrDA port cannot use DNP.

## C.3: Data Link Layer

The Shark® 200 meter can be assigned a value from 1 to 65534 as the target device address. The data link layer follows the standard frame FT3 used by DNP Version 3.0 protocol, but only 4 functions are implemented: Reset Link, Reset User, Unconfirmed User Data, and Link Status, as depicted in the following table.

| Function | Function Code |
|---|---|
| Reset Link | 0 |
| Reset User | 1 |
| Unconfirmed User Data | 4 |
| Link Status | 9 |

Table C.1: Supported Link Functions

[dst] and [src] are the device address of the Shark® 200 meter and Master device, respectively. Refer to Section C.7 for more detail on supported frames for the data link layer.

In order to establish optimal communication with the Shark® 200 meter, we recommend that you perform the Reset Link and Reset User functions. The Link Status is not mandatory, but can be performed as well. The inter-character time-out for DNP is 1 second. If this amount of time, or more, elapses between two consecutive characters within a FT3 frame, the frame will be dropped.

## C.4: Application Layer

The Shark® 200 meter's DNP version supports the Read, Write, Direct Operate and Direct Operate Unconfirmed functions.

- The Read function (code 01) provides a means for reading the critical measurement data from the meter. This function should be posted to read object 60 variation 1, which will read all the available Class 0 objects from the DNP register map. See the register map in Section C.6. In order to retrieve all objects with their respective variations, the qualifier must be set to ALL (0x06). See Section C.7 for an example showing a read Class 0 request data from the meter.

- The Write function (code 02) provides a means for clearing the Device restart bit in the Internal Indicator register only. This is mapped to Object 80, point 0 with variation 1. When clearing the restart device indicator use qualifier 0. Section C.7 shows the supported frames for this function.

- The Direct Operate function (code 05) is intended for resetting the energy counters and the Demand counters (minimum and maximum energy registers). These actions are mapped to Object 12, points 0 and 2, which act as control relays. The relays must be operated (On) in 0 msec and released (Off) in 1 msec only. Qualifiers 0x17 or x28 are supported for writing the energy reset. Sample frames are shown in Section C.7.

- The Direct Operate Unconfirmed (or Unacknowledged) function (code 06) is intended for asking the communication port to switch to Modbus RTU protocol from DNP. This switching acts as a control relay mapped into Object 12, point 1 in the meter. The relay must be operated with qualifier 0x17, code 3 count 0, with 0 milliseconds on and 1 millisecond off, only. After sending this request the current

communication port will accept Modbus RTU frames only. To make this port go back to DNP protocol, the unit must be powered down and up. Section C.7 shows the constructed frame to perform DNP to Modbus RTU protocol change.

## C.5: Error Reply

In the case of an unsupported function, or any other recognizable error, an error reply is generated from the Shark® 200 meter to the Primary station (the requester). The Internal Indicator field will report the type of error: unsupported function or bad parameter.

The broadcast acknowledge and restart bit are also signaled in the Internal Indicator field, but they do not indicate an error condition.

## C.6: Shark® 200 Meter's DNP Register Map

### Object 10 - Binary Output States

| Object | Point | Var | Description | Format | Range | Multiplier | Units | Comments |
|---|---|---|---|---|---|---|---|---|
| 10 | 0 | 2 | Reset Energy Counters | BYTE | Always 1 | N/A | None | Read by Class 0 or with qualifier 0, 1, 2, or 6 |
| 10 | 1 | 2 | Change to Modbus RTU Protocol | BYTE | Always 1 | N/A | None | Read by Class 0 or with qualifier 0, 1, 2, or 6 |
| 10 | 2 | 2 | Reset Demand Cntrs (Max / Min ) | BYTE | Always 1 | N/A | None | Read by Class 0 or with qualifier 0, 1, 2, or 6 |

### Object 12 - Control Relay Outputs

| Object | Point | Var | Description | Format | Range | Multiplier | Units | Comments |
|---|---|---|---|---|---|---|---|---|
| 12 | 0 | 1 | Reset Energy Counters | N/A | N/A | N/A | none | Responds to Function 5 (Direct Operate), Qualifier Code 17x or 28x, Control Code 3, Count 0, On 0 msec, Off 1 msec ONLY. |
| 12 | 1 | 1 | Change to Modbus RTU Protocol | N/A | N/A | N/A | none | Responds to Function 6 (Direct Operate - No Ack), Qualifier Code 17x, Control Code 3, Count 0, On 0 msec, Off 1 msec ONLY. |

| Object | Point | Var | Description | Format | Range | Multiplier | Units | Comments |
|---|---|---|---|---|---|---|---|---|
| 12 | 2 | 1 | Reset Demand Counters (Max / Min) | N/A | N/A | N/A | none | Responds to Function 5 (Direct Operate), Qualifier Code 17x or 28x, Control Code 3, Count 0, On 0 msec, Off 1 msec ONLY. |

**Object 20 - Binary Counters (Primary Readings) - Read via Class 0 or with qualifier 0, 1, 2, or 6**

| Object | Point | Var | Description | Format | Range | Multiplier | Units | Comments |
|---|---|---|---|---|---|---|---|---|
| 20 | 0 | 5 | W-hours, Positive | UINT32 | 0 to 99999999 | Multiplier = 10(n-d), where n and d are derived from the energy format. n = 0, 3, or 6 per energy format scale and d = number of decimal places. | Whr | example: energy format = 7.2K and W-hours counter = 1234567 n=3 (K scale), d=2 ( 2 digits after decimal point), multiplier = 10(3-2) = 101 = 10, so energy is 1234567 * 10 Whrs, or 12345.67 KWhrs |
| 20 | 1 | 5 | W-hours, Negative | UINT32 | 0 to 99999999 | | Whr | |
| 20 | 2 | 5 | VAR-hours, Positive | UINT32 | 0 to 99999999 | | VARhr | |
| 20 | 3 | 5 | VAR-hours, Negative | UINT32 | 0 to 99999999 | | VARhr | |
| 20 | 4 | 5 | VA-hours, Total | UINT32 | 0 to 99999999 | | VAhr | |

**Object 30 - Analog Inputs (Secondary Readings) - Read via Class 0 or with qualifier 0, 1, 2, or 6**

| Object | Point | Var | Description | Format | Range | Multiplier | Units | Comments |
|---|---|---|---|---|---|---|---|---|
| 30 | 0 | 4 | Meter Health | SINT16 | 0 or 1 | N/A | None | 0 = OK |
| 30 | 1 | 4 | Volts A-N | SINT16 | 0 to 32767 | (150 / 32768) | V | Values above 150V secondary read 32767. |
| 30 | 2 | 4 | Volts B-N | SINT16 | 0 to 32767 | (150 / 32768) | V | |
| 30 | 3 | 4 | Volts C-N | SINT16 | 0 to 32767 | (150 / 32768) | V | |

| Object | Point | Var | Description | Format | Range | Multiplier | Units | Comments |
|---|---|---|---|---|---|---|---|---|
| 30 | 4 | 4 | Volts A-B | SINT16 | 0 to 32767 | (300 / 32768) | V | Values above 300V secondary read 32767. |
| 30 | 5 | 4 | Volts B-C | SINT16 | 0 to 32767 | (300 / 32768) | V | |
| 30 | 6 | 4 | Volts C-A | SINT16 | 0 to 32767 | (300 / 32768) | V | |
| 30 | 7 | 4 | Amps A | SINT16 | 0 to 32767 | (10 / 32768) | A | Values above 10A secondary read 32767. |
| 30 | 8 | 4 | Amps B | SINT16 | 0 to 32767 | (10 / 32768) | A | |
| 30 | 9 | 4 | Amps C | SINT16 | 0 to 32767 | (10 / 32768) | A | |
| 30 | 10 | 4 | Watts, 3-Ph total | SINT16 | -32768 to +32767 | (4500 / 32768) | W | |
| 30 | 11 | 4 | VARs, 3-Ph total | SINT16 | -32768 to +32767 | (4500 / 32768) | VAR | |
| 30 | 12 | 4 | VAs, 3-Ph total | SINT16 | 0 to +32767 | (4500 / 32768) | VA | |
| 30 | 13 | 4 | Power Factor, 3-Ph total | SINT16 | -1000 to +1000 | 0.001 | None | |
| 30 | 14 | 4 | Frequency | SINT16 | 0 to 9999 | 0.01 | Hz | |
| 30 | 15 | 4 | Positive Watts, 3-Ph, Maximum Avg Demand | SINT16 | -32768 to +32767 | (4500 / 32768) | W | |
| 30 | 16 | 4 | Positive VARs, 3-Ph, Maximum Avg Demand | SINT16 | -32768 to +32767 | (4500 / 32768) | VAR | |
| 30 | 17 | 4 | Negative Watts, 3-Ph, Maximum Avg Demand | SINT16 | -32768 to +32767 | (4500 / 32768) | W | |
| 30 | 18 | 4 | Negative VARs, 3-Ph, Maximum Avg Demand | SINT16 | -32768 to +32767 | (4500 / 32768) | VAR | |
| 30 | 19 | 4 | VAs, 3-Ph, Maximum Avg Demand | SINT16 | -32768 to +32767 | (4500 / 32768) | VA | |
| 30 | 20 | 4 | Angle, Phase A Current | SINT16 | -1800 to +1800 | 0.1 | degree | |

| Object | Point | Var | Description | Format | Range | Multiplier | Units | Comments |
|---|---|---|---|---|---|---|---|---|
| 30 | 21 | 4 | Angle, Phase B Current | SINT16 | -1800 to +1800 | 0.1 | degree | |
| 30 | 22 | 4 | Angle, Phase C Current | SINT16 | -1800 to +1800 | 0.1 | degree | |
| 30 | 23 | 4 | Angle, Volts A-B | SINT16 | -1800 to +1800 | 0.1 | degree | |
| 30 | 24 | 4 | Angle, Volts B-C | SINT16 | -1800 to +1800 | 0.1 | degree | |
| 30 | 25 | 4 | Angle, Volts C-A | SINT16 | -1800 to +1800 | 0.1 | degree | |
| 30 | 26 | 4 | CT numerator | SINT16 | 1 to 9999 | N/A | none | CT ratio = (numerator * multiplier) / denomina-tor |
| 30 | 27 | 4 | CT multiplier | SINT16 | 1, 10, or 100 | N/A | none | |
| 30 | 28 | 4 | CT denominator | SINT16 | 1 or 5 | N/A | none | |
| 30 | 29 | 4 | PT numerator | SINT16 | 1 to 9999 | N/A | none | PT ratio = (numerator * multiplier) / denomina-tor |
| 30 | 30 | 4 | PT multiplier | SINT16 | 1, 10, or 100 | N/A | none | |
| 30 | 31 | 4 | PT denominator | SINT16 | 1 to 9999 | N/A | none | |
| 30 | 32 | 4 | Neutral Current | SINT16 | 0 to 32767 | (10 / 32768) | A | For 1A model, mul-tiplier is (2 / 32768) and values above 2A secondary read 32767 |
| 30 | 33 | 4 | PowerFactor, Phase A | SINT16 | -1000 to +1000 | 0.001 | None | |
| 30 | 34 | 4 | Power Factor, Phase B | SINT16 | -1000 to +1000 | 0.001 | None | |
| 30 | 35 | 4 | Power Factor, Phase C | SINT16 | -1000 to +1000 | 0.001 | None | |
| 30 | 36 | 4 | Watts, Phase A | SINT16 | -32768 to +32767 | (4500/32768) | W | |
| 30 | 37 | 4 | Watts, Phase B | SINT16 | -32768 to +32767 | (4500/32768) | W | |
| 30 | 38 | 4 | Watts, Phase C | SINT16 | -32768 to +32767 | (4500/32768) | W | |
| 30 | 39 | 4 | VARs, Phase A | SINT16 | -32768 to +32767 | (4500/32768) | VAR | |

| Object | Point | Var | Description | Format | Range | Multiplier | Units | Comments |
|---|---|---|---|---|---|---|---|---|
| 30 | 40 | 4 | VARS, Phase B | SINT16 | -32768 to +32767 | (4500/32768) | VAR | |
| 30 | 41 | 4 | VARs, Phase C | SINT16 | -32768 to +32767 | (4500/32768) | VAR | |

**Object 30 - Analog Inputs (Primary Readings) - Read via Class 0 or with qualifier 0, 1, 2, 6**

**NOTE:** Multipliers for Volts, Amps, and Power points are per user setup options.

| Object | Point | Var | Description | Format | Range | Multiplier | Units | Comments |
|---|---|---|---|---|---|---|---|---|
| 30 | 0 | 4 | Meter Health | SINT16 | 0 or 1 | N/A | None | 0 = OK |
| 30 | 1 | 4 | Volts A-N | SINT16 | 0 to 32767 | 1, 10, or 100 | V | Point value = Actual Volts/divisor |
| 30 | 2 | 4 | Volts B-N | SINT16 | 0 to 32767 | 1, 10, or 100 | V | |
| 30 | 3 | 4 | Volts C-N | SINT16 | 0 to 32767 | 1, 10, or 100 | V | |
| 30 | 4 | 4 | Volts A-B | SINT16 | 0 to 32767 | 1, 10, or 100 | V | |
| 30 | 5 | 4 | Volts B-C | SINT16 | 0 to 32767 | 1, 10, or 100 | V | |
| 30 | 6 | 4 | Volts C-A | SINT16 | 0 to 32767 | 1, 10, or 100 | V | |
| 30 | 7 | 4 | Amps A | SINT16 | 0 to 32767 | 1 or 10 | A | Point value = Actual Amps/divisor |
| 30 | 8 | 4 | Amps B | SINT16 | 0 to 32767 | 1 or 10 | A | |
| 30 | 9 | 4 | Amps C | SINT16 | 0 to 32767 | 1 or 10 | A | |
| 30 | 10 | 4 | Watts, 3-Ph total | SINT16 | -32768 to +32767 | 1, 10, 100 or 1000 | W | Point value = Actual kWatts/divisor |
| 30 | 11 | 4 | VARs, 3-Ph total | SINT16 | -32768 to +32767 | 1, 10, 100 or 1000 | VAR | |
| 30 | 12 | 4 | VAs, 3-Ph total | SINT16 | 0 to +32767 | 1, 10, 100 or 1000 | VA | |

| Object | Point | Var | Description | Format | Range | Multiplier | Units | Comments |
|---|---|---|---|---|---|---|---|---|
| 30 | 13 | 4 | Power Factor, 3-Ph total | SINT16 | -1000 to +1000 | 0.001 | None | |
| 30 | 14 | 4 | Frequency | SINT16 | 0 to 9999 | 0.01 | Hz | |
| 30 | 15 | 4 | Positive Watts, 3-Ph, Maximum Avg Demand | SINT16 | -32768 to +32767 | 1, 10, 100, or 1000 | W | |
| 30 | 16 | 4 | Positive VARs, 3-Ph, Maximum Avg Demand | SINT16 | -32768 to +32767 | 1, 10, 100, or 1000 | VAR | |
| 30 | 17 | 4 | Negative Watts, 3-Ph, Maximum Avg Demand | SINT16 | -32768 to +32767 | 1, 10, 100, or 1000 | W | |
| 30 | 18 | 4 | Negative VARs, 3-Ph, Maximum Avg Demand | SINT16 | -32768 to +32767 | 1, 10, 100, or 1000 | VAR | |
| 30 | 19 | 4 | VAs, 3-Ph, Maximum Avg Demand | SINT16 | -32768 to +32767 | 1, 10, 100, or 1000 | VA | |
| 30 | 20 | 4 | Angle, Phase A Current | SINT16 | -1800 to +1800 | 0.1 | degree | |
| 30 | 21 | 4 | Angle, Phase B Current | SINT16 | -1800 to +1800 | 0.1 | degree | |
| 30 | 22 | 4 | Angle, Phase C Current | SINT16 | -1800 to +1800 | 0.1 | degree | |
| 30 | 23 | 4 | Angle, Volts A-B | SINT16 | -1800 to +1800 | 0.1 | degree | |
| 30 | 24 | 4 | Angle, Volts B-C | SINT16 | -1800 to +1800 | 0.1 | degree | |
| 30 | 25 | 4 | Angle, Volts C-A | SINT16 | -1800 to +1800 | 0.1 | degree | |
| 30 | 26 | 4 | CT numerator | SINT16 | 1 to 9999 | N/A | none | CT ratio = (numerator * multiplier) / denomina-tor |
| 30 | 27 | 4 | CT multiplier | SINT16 | 1, 10, or 100 | N/A | none | |
| 30 | 28 | 4 | CT denominator | SINT16 | 1 or 5 | N/A | none | |
| 30 | 29 | 4 | PT numerator | SINT16 | 1 to 9999 | N/A | none | PT ratio = (numerator * multiplier) / denomina-tor |
| 30 | 30 | 4 | PT multiplier | SINT16 | 1, 10, or 100 | N/A | none | |
| 30 | 31 | 4 | PT denominator | SINT16 | 1 to 9999 | N/A | none | |

| Object | Point | Var | Description | Format | Range | Multiplier | Units | Comments |
|---|---|---|---|---|---|---|---|---|
| 30 | 32 | 4 | Neutral Current | SINT16 | 0 to 32767 | (10 / 32768) | A | Point value = Actual Amps/divisor |
| 30 | 33 | 4 | PowerFactor, Phase A | SINT16 | -1000 to +1000 | 0.001 | None | |
| 30 | 34 | 4 | Power Factor, Phase B | SINT16 | -1000 to +1000 | 0.001 | None | |
| 30 | 35 | 4 | Power Factor, Phase C | SINT16 | -1000 to +1000 | 0.001 | None | |
| 30 | 36 | 4 | Watts, Phase A | SINT16 | -32768 to +32767 | (4500/32768) | W | |
| 30 | 37 | 4 | Watts, Phase B | SINT16 | -32768 to +32767 | (4500/32768) | W | |
| 30 | 38 | 4 | Watts, Phase C | SINT16 | -32768 to +32767 | (4500/32768) | W | |
| 30 | 39 | 4 | VARs, Phase A | SINT16 | -32768 to +32767 | (4500/32768) | VAR | |
| 30 | 40 | 4 | VARS, Phase B | SINT16 | -32768 to +32767 | (4500/32768) | VAR | |
| 30 | 41 | 4 | VARs, Phase C | SINT16 | -32768 to +32767 | (4500/32768) | VAR | |

### Object 80 - Internal Indicator

| Object | Point | Var | Description | Format | Range | Multiplier | Units | Comments |
|---|---|---|---|---|---|---|---|---|
| 80 | 7 | 1 | Device Restart Bit | N/A | N/A | N/A | none | Clear via Function 2 (Write), Qualifier Code 0. |

## C.7: DNP Message Layouts

### Legend

All numbers are in hexadecimal base. In addition the following symbols are used.

| | |
|---|---|
| dst | 16 bit frame destination address |
| src | 16 bit frame source address |
| crc | DNP Cyclic redundant checksum (polynomial $x^{16}+x^{13}+x^{12}+x^{11}+x^{10}+x^{7}+x^{6}+x^{5}+x^{2}+1$) |

| | |
|---|---|
| x | transport layer data sequence number |
| y | application layer data sequence number |

**Link Layer related frames**

Reset Link

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Request | 05 | 64 | 05 | C0 | dst | src | crc |
| Reply | 05 | 64 | 05 | 00 | src | dst | crc |

Reset User

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Request | 05 | 64 | 05 | C1 | dst | src | crc |
| Reply | 05 | 64 | 05 | 00 | src | dst | crc |

Link Status

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Request | 05 | 64 | 05 | C9 | dst | src | crc |
| Reply | 05 | 64 | 05 | 0B | src | dst | crc |

**Application Layer related frames**

Clear Restart

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Request | 05 | 64 | 0E | C4 | dst | | src | | crc | |
| | Cx | Cy | 02 | 50 | 01 | 00 | 07 | 07 | 00 | crc |
| Reply | 05 | 64 | 0A | 44 | src | | dst | | crc | |
| | Cx | Cy | 81 | Int. Ind. | | | crc | | | |

Class 0 Data

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Request | 05 | 64 | 0B | C4 | dst | | src | | crc | | | | | | |
| | Cx | Cy | 01 | 3C | 01 | 06 | crc | | | | | | | | |
| Request (alternate) | 05 | 64 | 14 | C4 | dst | | src | | crc | | | | | | |
| | Cx | Cy | 01 | 3C | 02 | 06 | 3C | 03 | 06 | 3C | 04 | 06 | 3C | 01 | 06 | crc |

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reply (same for either request) | 05 | 64 | 72 | 44 | src | | dst | | crc | | | | | | | | | | | | | | | |
| | Cx | Cy | 81 | int. ind. | | 14 | 05 | 00 | 00 | 04 | pt 0 | | | | | | | pt 1 | | | | | crc | |
| | pt 1 | | | pt 2 | | | | pt 3 | | | | | | pt 4 | | | | | 1E | | 04 | | crc | |
| | 00 | 00 | 20 | pt 0 | | pt 1 | | pt 2 | | pt 3 | | pt 4 | | | pt 5 | | | | | pt6 | | | crc | |
| | pt6 | | pt 7 | | pt 8 | | pt 9 | | pt 10 | | pt 11 | | pt 12 | | pt 13 | | | | | | | | crc | |
| | | | pt 15 | | pt 16 | | pt 17 | | pt 18 | | pt 19 | | pt 20 | | pt 21 | | | | | | | | crc | |
| | | | pt 23 | | pt 24 | | pt 25 | | pt 26 | | pt 27 | | pt 28 | | pt 29 | | | | | | | | crc | |
| | | | pt 31 | | pt 32 | | 0A | 02 | 00 | 00 | 02 | pt0 | pt1 | pt2 | crc | | | | | | | | | |

Reset Energy

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Request | 05 | 64 | 18 | C4 | dst | | src | | crc | | | | | | | | | | | | | | | |
| | Cx | Cy | 05 | 0C | 01 | 17 | 01 | 00 | 03 | 00 | 00 | 00 | 00 | 00 | 01 | 00 | crc | | | | | | | |
| | 00 | 00 | 00 | crc | | | | | | | | | | | | | | | | | | | | |
| Reply | 05 | 64 | 1A | 44 | src | | dst | | crc | | | | | | | | | | | | | | | |
| | Cx | Cy | 81 | int. ind. | | 0C | 01 | 17 | 01 | 00 | 03 | 00 | 00 | 00 | 00 | 00 | crc | | | | | | | |
| | 01 | 00 | 00 | 00 | 00 | crc | | | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Request (alternate) | 05 | 64 | 1A | C4 | dst | | src | | crc | | | | | | | | | | | | | | | |
| | Cx | Cy | 05 | 0C | 01 | 28 | 01 | 00 | 00 | 00 | 03 | 00 | 00 | 00 | 00 | 00 | crc | | | | | | | |
| | 01 | 00 | 00 | 00 | 00 | crc | | | | | | | | | | | | | | | | | | |
| Reply | 05 | 64 | 1C | 44 | src | | dst | | crc | | | | | | | | | | | | | | | |
| | Cx | Cy | 81 | int. ind. | | 0C | 01 | 28 | 01 | 00 | 00 | 00 | 03 | 00 | 00 | 00 | crc | | | | | | | |
| | 00 | 00 | 01 | 00 | 00 | 00 | 00 | crc | | | | | | | | | | | | | | | | |

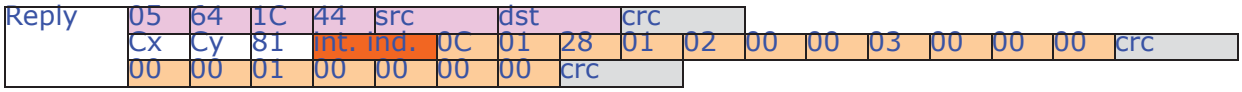
Switch to Modbus

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Request | 05 | 64 | 18 | C4 | dst | | src | | crc | | | | | | | | | | | | | | | |
| | Cx | Cy | 06 | 0C | 01 | 17 | 01 | 01 | 03 | 00 | 00 | 00 | 00 | 00 | 01 | 00 | crc | | | | | | | |
| | 00 | 00 | 00 | crc | | | | | | | | | | | | | | | | | | | | |
| No Reply | | | | | | | | | | | | | | | | | | | | | | | | |

Reset Demand (Maximums & Minimums)

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Request | 05 | 64 | 18 | C4 | dst | | src | | crc | | | | | | | | | | | | | | | |
| | Cx | Cy | 05 | 0C | 01 | 17 | 01 | 02 | 03 | 00 | 00 | 00 | 00 | 00 | 01 | 00 | crc | | | | | | | |
| | 00 | 00 | 00 | crc | | | | | | | | | | | | | | | | | | | | |
| Reply | 05 | 64 | 1A | 44 | src | | dst | | crc | | | | | | | | | | | | | | | |
| | Cx | Cy | 81 | int. ind. | | 0C | 01 | 17 | 01 | 02 | 03 | 00 | 00 | 00 | 00 | 00 | crc | | | | | | | |
| | 01 | 00 | 00 | 00 | 00 | crc | | | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Request (alternate) | 05 | 64 | 1A | C4 | dst | | src | | crc | | | | | | | | | | | | | | | |
| | Cx | Cy | 05 | 0C | 01 | 28 | 01 | 02 | 00 | 00 | 03 | 00 | 00 | 00 | 00 | 00 | crc | | | | | | | |
| | 01 | 00 | 00 | 00 | 00 | crc | | | | | | | | | | | | | | | | | | |




Error Reply

## C.8: Internal Indication Bits

Bits implemented in the Shark® 200 meter are listed below. All others are always reported as zeroes.

**Bad Function**

Occurs if the function code in a User Data request is not Read (0x01), Write (0x02), Direct Operate (0x05), or Direct Operate, No Ack (0x06).

**Object Unknown**

Occurs if an unsupported object is specified for the Read function. Only objects 10, 20, 30, and 60 are supported.

**Out of Range**

Occurs for most other errors in arequest, such as requesting points that don't exist or direct operate requests in unsupported formats.

**Buffer Overflow**

Occurs if a read request or a read response is too large for its respective buffer. In general, if the request overflows, there will be no data in the response while if the response overflows at least the first object will be returned. The largest acceptable request has a length field of 26, i.e. link header plus 21 bytes more, not counting checksums. The largest possible response has 7 blocks plus the link header.

**Restart**

**All Stations**

These 2 bits are reported in accordance with standard practice.

# D: Using the USB to IrDA Adapter (CAB6490)

## D.1: Introduction

Com 1 of the Shark® 200 meter is the IrDA port, located on the face of the meter. One way to communicate with the IrDA port is with EIG's USB to IrDA Adapter (CAB6490), which allows you to access the Shark® 200 meter's data from a PC. This Appendix contains instructions for installing the USB to IrDA Adapter.

## D.2: Installation Procedures

The USB to IrDA Adapter comes packaged with a USB cable and an Installation CD. Follow this procedure to install the Adapter on your PC.

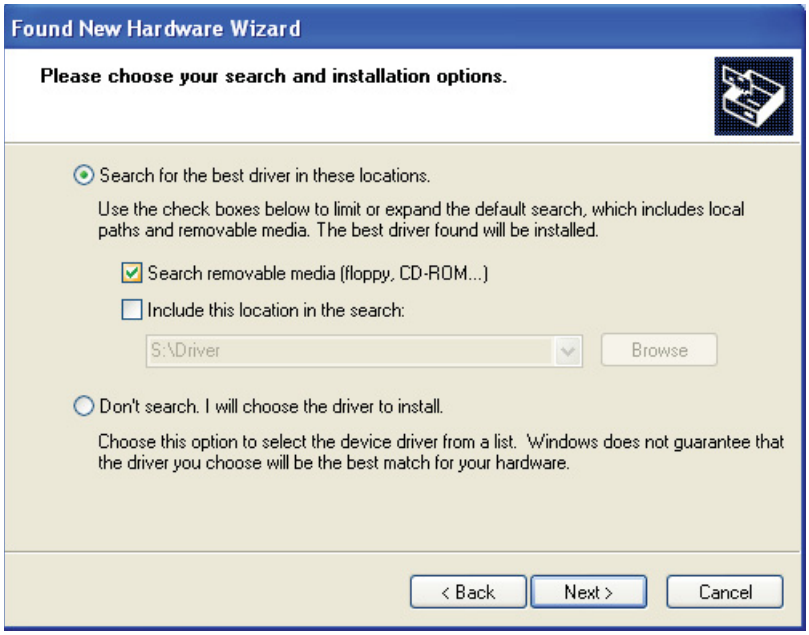
1. Connect the USB cable to the USB to IrDA Adapter, and plug the USB into your PC's USB port.

2. Insert the Installation CD into your PC's CD ROM drive.

3. You will see the screen shown below. The Found New Hardware Wizard allows you to install the software for the Adapter. Click the Radio Button next to Install from a list or specific location.

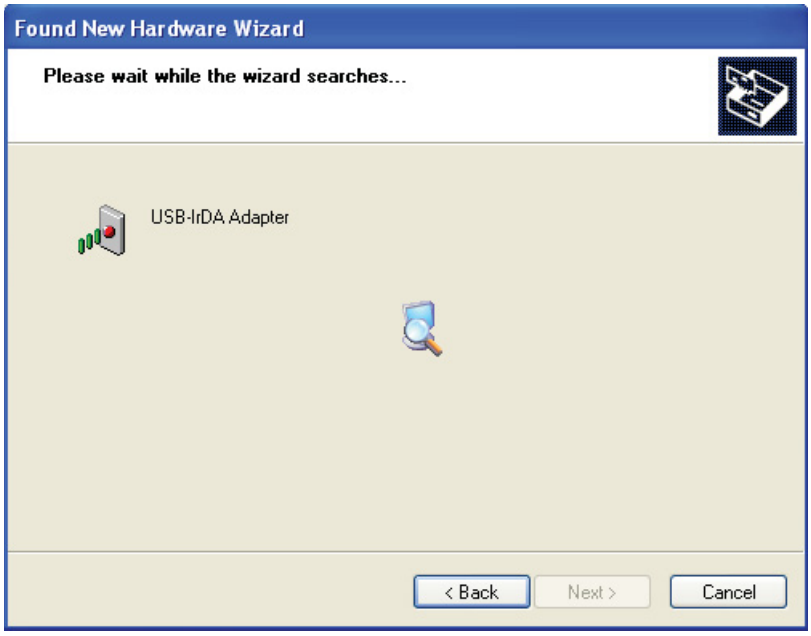
Found New Hardware Wizard
Welcome to the Found New Hardware Wizard
This wizard helps you install software for:
USB-IrDA Adapter
If your hardware came with an installation CD or floppy disk, insert it now.
What do you want the wizard to do?
Install the software automatically (Recommended)
Install from a list or specific location (Advanced)
Click Next to continue.
< Back
Next >
Cancel

4. Click **Next**. You will see the screen shown on the next page.

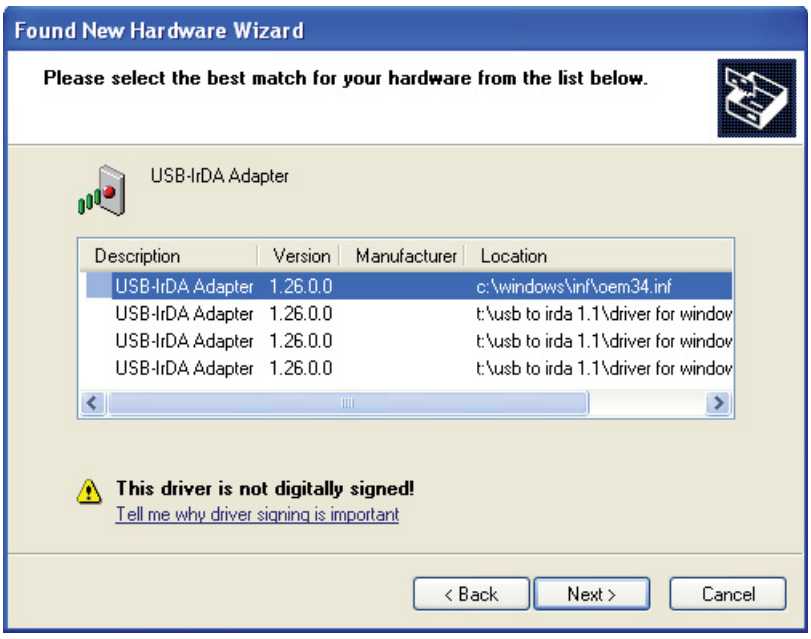

Found New Hardware Wizard
Please choose your search and installation options.
Search for the best driver in these locations.
Use the check boxes below to limit or expand the default search, which includes local paths and removable media. The best driver found will be installed.
Search removable media (floppy, CD-ROM...)
Include this location in the search:
S:\Driver
Browse
Don't search. I will choose the driver to install.
Choose this option to select the device driver from a list. Windows does not guarantee that the driver you choose will be the best match for your hardware.
< Back
Next >
Cancel

5. Make sure the first Radio Button and the first Checkbox are selected, as shown in the above screen. These selections allow the Adapter's driver to be copied from the Installation disk to your PC.

6. Click **Next**. You will see the screen shown below.

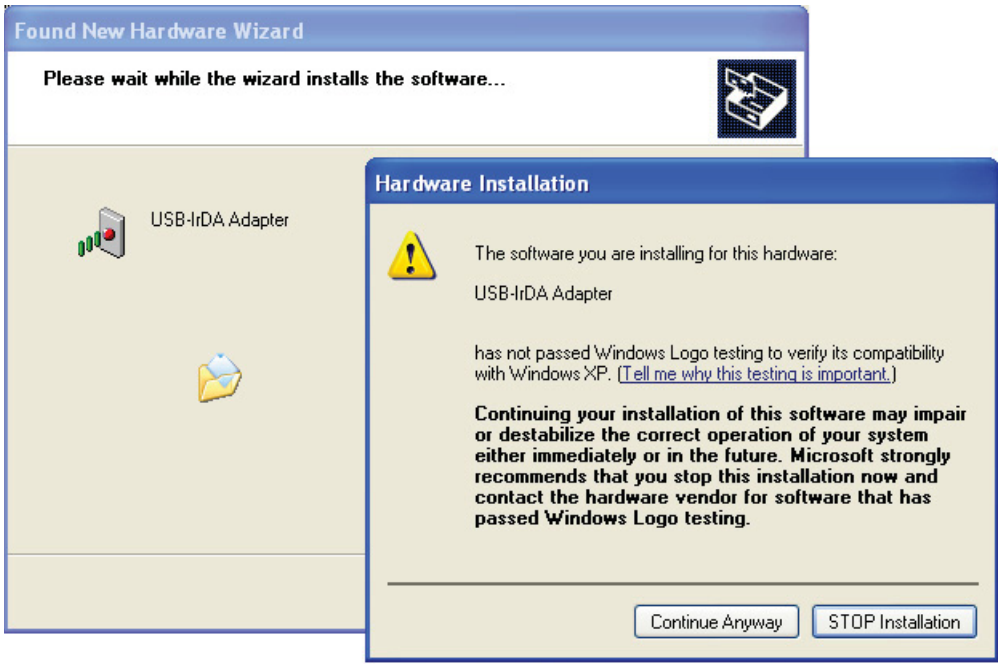


7. When the driver for the Adapter is found, you will see the screen shown below.

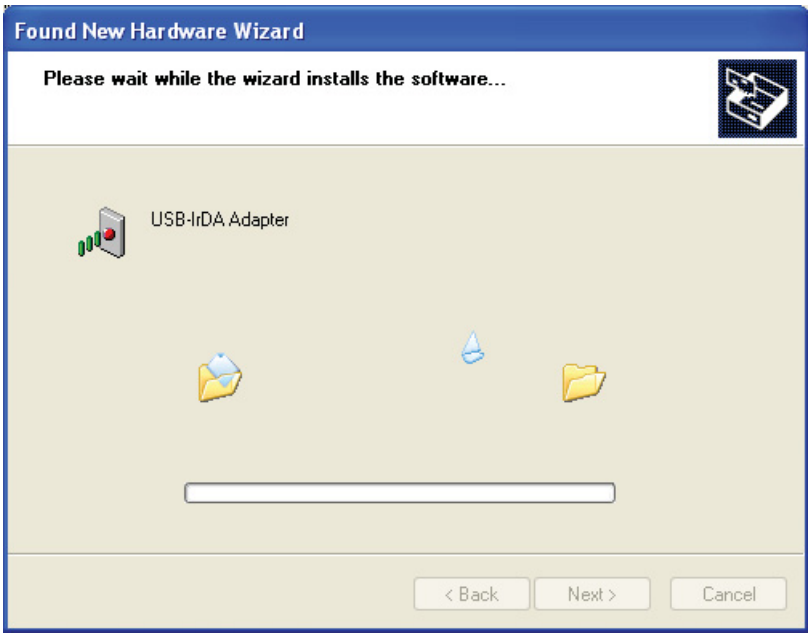

Found New Hardware Wizard
Please select the best match for your hardware from the list below.
USB-IrDA Adapter
Description
Version
Manufacturer
Location
USB-IrDA Adapter 1.26.0.0 c:\windows\inf\oem34.inf
USB-IrDA Adapter 1.26.0.0 t:\usb to irda 1.1\driver for windov
USB-IrDA Adapter 1.26.0.0 t:\usb to irda 1.1\driver for windov
USB-IrDA Adapter 1.26.0.0 t:\usb to irda 1.1\driver for windov
This driver is not digitally signed!
Tell me why driver signing is important
< Back
Next >
Cancel

8. You do not need to be concerned about the message on the bottom of the screen. Click **Next** to continue with the installation.

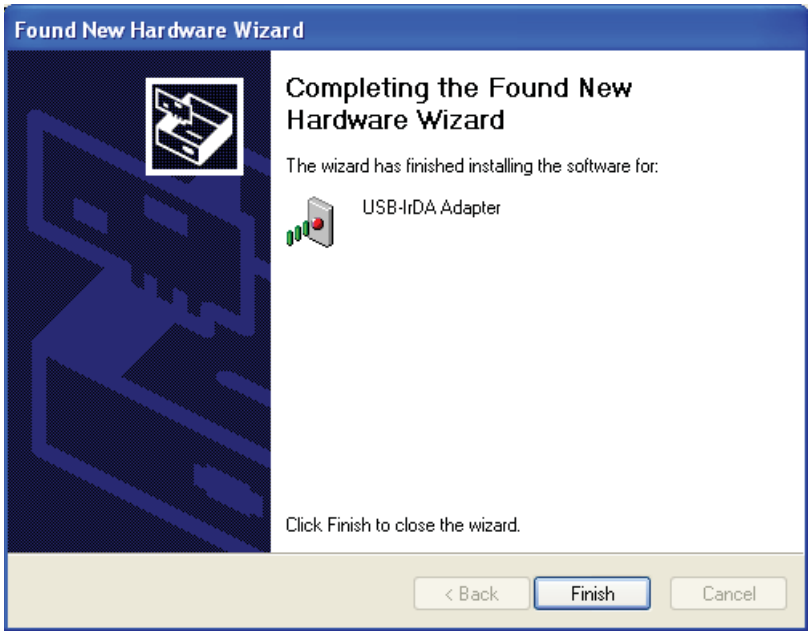
9. You will see the two windows shown below. Click **Continue Anyway**.


Found New Hardware Wizard
Please wait while the wizard installs the software...
USB-IrDA Adapter
Hardware Installation
The software you are installing for this hardware:
USB-IrDA Adapter
has not passed Windows Logo testing to verify its compatibility with Windows XP. (Tell me why this testing is important.)
Continuing your installation of this software may impair or destabilize the correct operation of your system either immediately or in the future. Microsoft strongly recommends that you stop this installation now and contact the hardware vendor for software that has passed Windows Logo testing.
Continue Anyway
STOP Installation

10. You will see the screen shown on the next page while the Adapter's driver is being installed on your PC.




11. When the driver installation is complete, you will see the screen shown below.




12. Click **Finish** to close the Found New Hardware Wizard.

**IMPORTANT! Do NOT remove the Installation CD until the entire procedure has completed.**

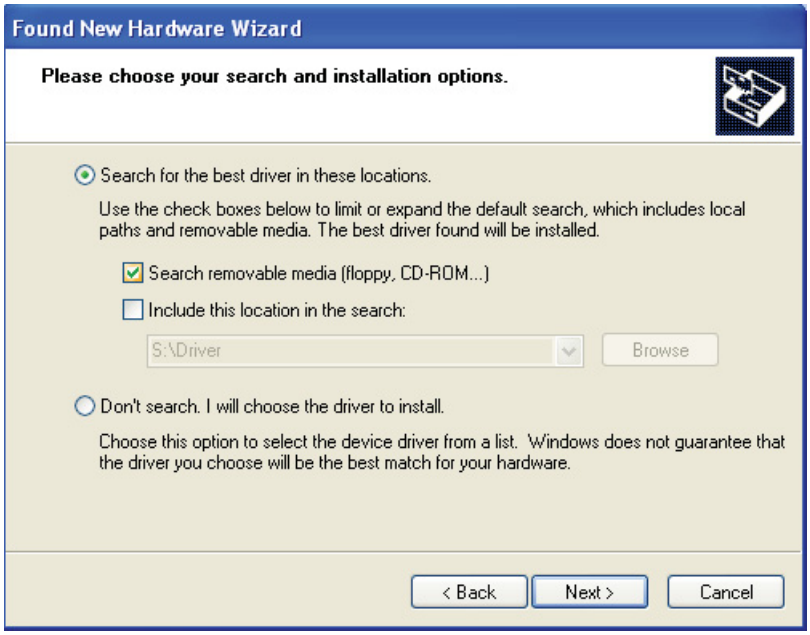
13. Position the USB to IrDA Adapter so that it points directly at the IrDA on the front of the Shark® 200 meter. It should be as close as possible to the meter, and not more than 15 inches/38 cm away from it.

14. The Found New Hardware Wizard screen opens again.

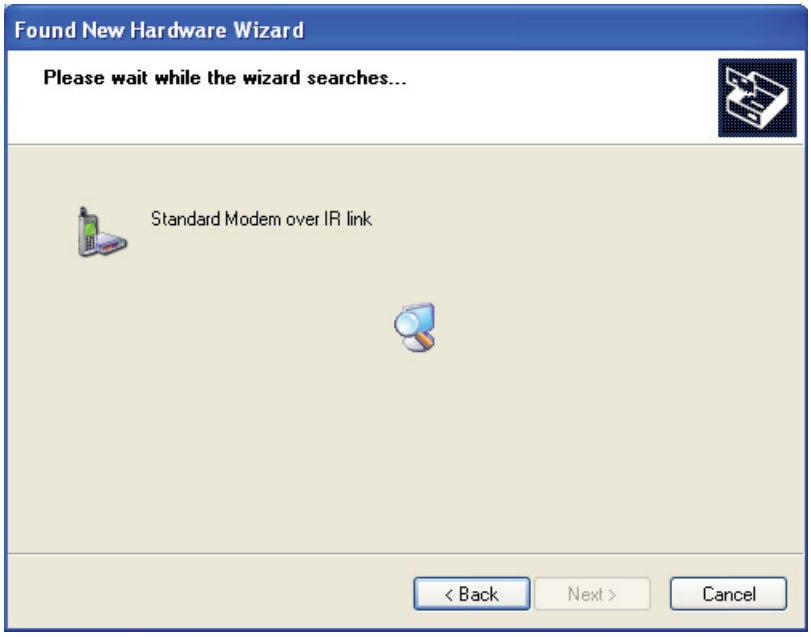
Found New Hardware Wizard
Welcome to the Found New Hardware Wizard
This wizard helps you install software for:
USB-IrDA Adapter
If your hardware came with an installation CD or floppy disk, insert it now.
What do you want the wizard to do?
Install the software automatically (Recommended)
Install from a list or specific location (Advanced)
Click Next to continue.
< Back
Next >
Cancel

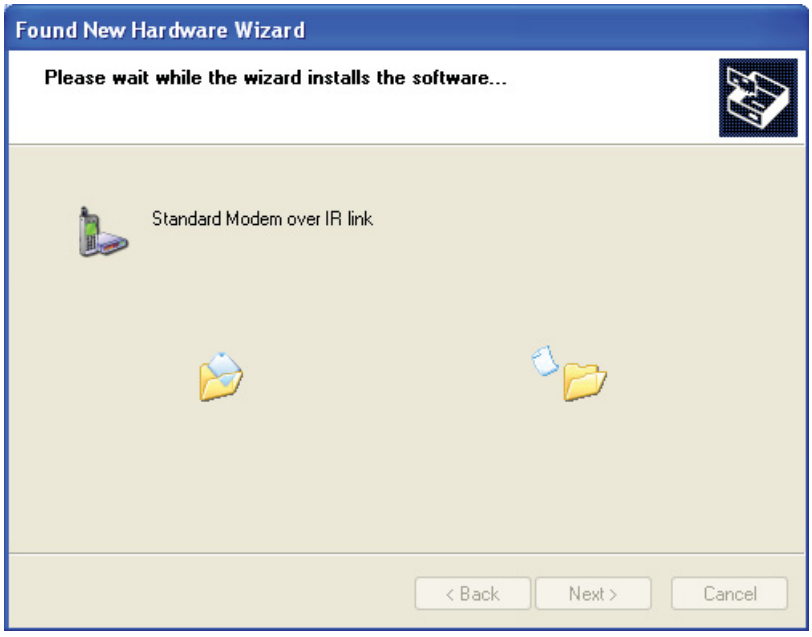
This time, click the Radio Button next to Install the software automatically.

15. Click **Next**. You will see the screen shown below.

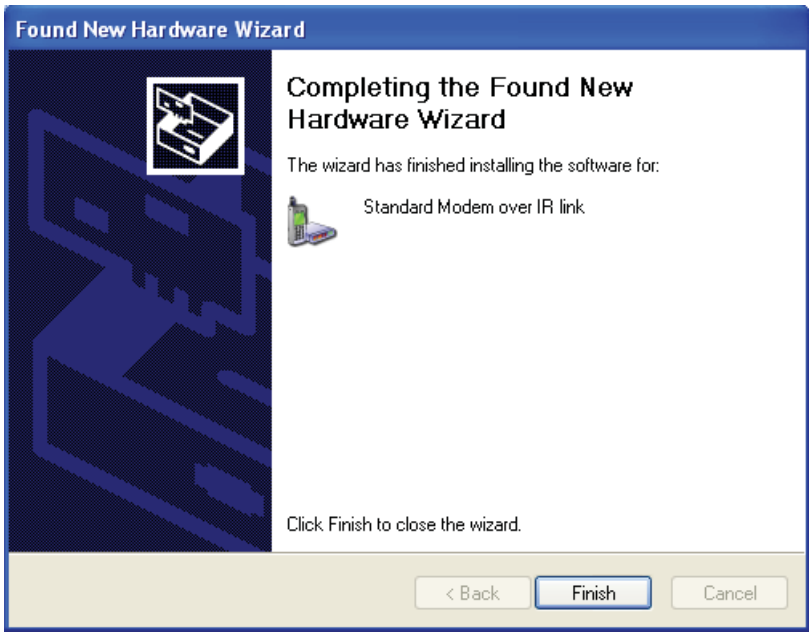

Found New Hardware Wizard
Please choose your search and installation options.
Search for the best driver in these locations.
Use the check boxes below to limit or expand the default search, which includes local paths and removable media. The best driver found will be installed.
Search removable media (floppy, CD-ROM...)
Include this location in the search:
S:\Driver
Browse
Don't search. I will choose the driver to install.
Choose this option to select the device driver from a list. Windows does not guarantee that the driver you choose will be the best match for your hardware.
< Back
Next >
Cancel

16. Make sure the first Radio Button and the first Checkbox are selected, as shown in the above screen. Click **Next**. You will see the two screens shown below.



17. When the installation is complete, you will see the screen shown below.


Found New Hardware Wizard
Completing the Found New Hardware Wizard
The wizard has finished installing the software for:
Standard Modem over IR link
Click Finish to close the wizard.
< Back
Finish
Cancel

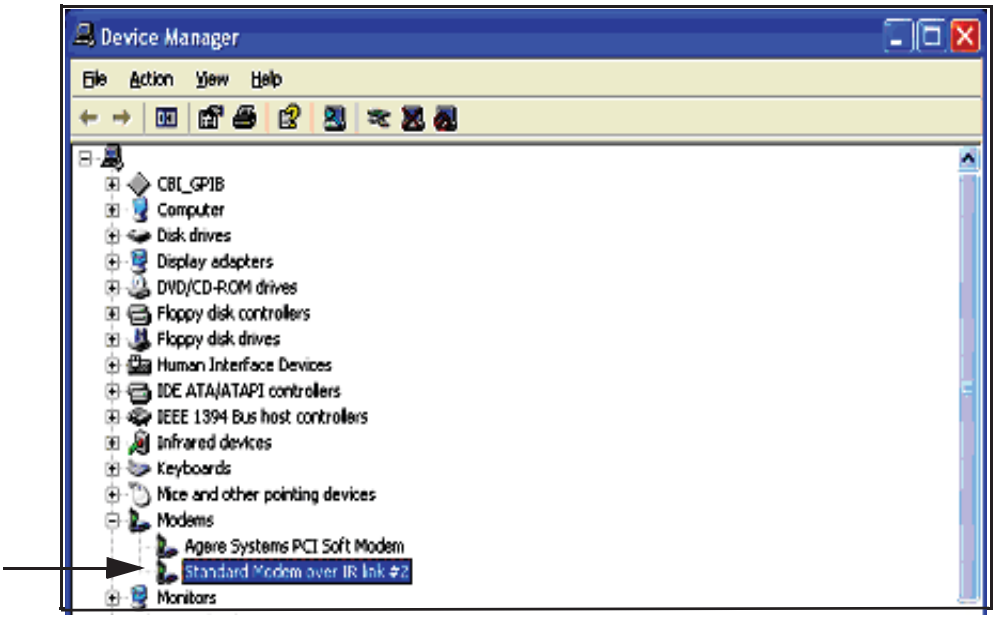
Click **Finish** to close the Found New Hardware Wizard.

18. To verify that your Adapter has been installed properly, click:

**Start>Settings>Control Panel>System>Hardware>Device Manager.**

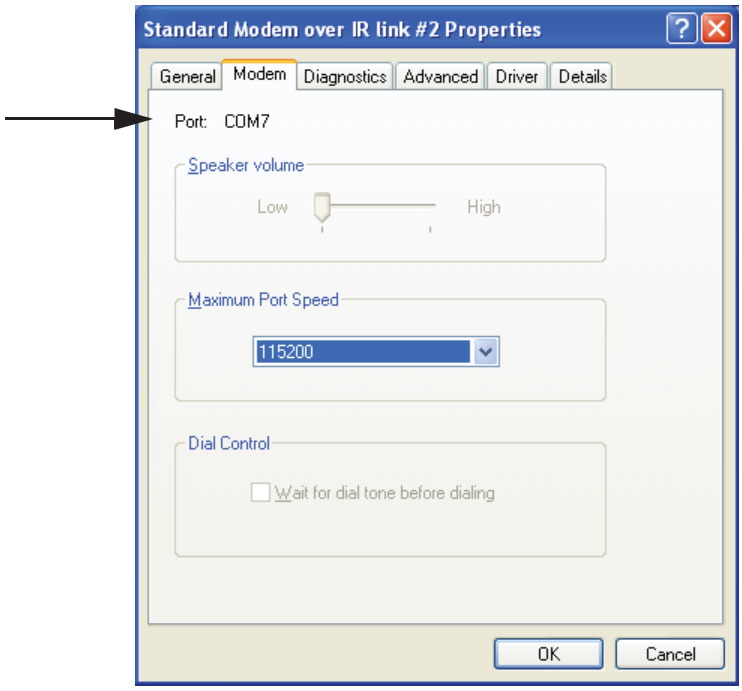
The USB to IrDA Adapter should appear under both Infrared Devices and Modems (click on the + sign to display all configured modems). See the example screen below.

**NOTE:** If the Adapter doesn't show up under Modems, move it away from the meter for a minute and then position it pointing at the IrDA, again.



19. Double-click on the Standard Modem over IR link (this is the USB to IrDA Adapter). You will see the Properties screen for the Adapter.

20. Click the Modem tab. The Com Port that the Adapter is using is displayed in the screen.




21. Use this Com Port to connect to the meter from your PC, using the Communicator EXT software. Refer to Chapter 5 of the *Communicator EXT 3.0 User Manual* for detailed connection instructions.